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1374 United States 1374

Circuit Court of Appeals

For the Ninth Circuit.

Transcript of Record.

(IN THREE VOLUMES.)

OSKAR HUBER,

Appellant,

vs.

WARREN BROTHERS COMPANY, a Corporation,

Appellee.

VOLUME III.

(Pages 961 to 1519, Inclusive.)

Upon Appeal from the United States District Court for the District of Oregon.

Filmer Bros. Co. Print, 330 Jackson St., S. F., Cal.

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prise the Court that you had applied for leave to take that deposition and that the order had been denied?

The COURT.—Yes, he stated that.

(Said deposition was thereupon marked Defendant's Exhibit "Y.") [874—330]

Thereupon defendant offered in evidence the notice upon which the deposition of Clifford Richardson was taken, the deposition of Clifford Richardson, and the certificate of the notary showing the compliance with Section 863 of the Revised Statutes of the United States, which the Court refused to receive in evidence. Whereupon said defendant excepted and said deposition was, over the ruling of the Court, marked Defendant's Exhibit "Y." [875—331]

Counsel for plaintiff admitted that there was now pending in the Exchequer Court at Ottawa, Canada, a suit in which the Bitulithic Paving Company and Warren Bros. Company are complainants and the city of Montreal is defendant, in which is involved a Canadian patent, which counsel understands is the same as United States patent 727,505. Though the form of the claim is not necessarily the same as the American, it covers substantially the same invention.

Mr. LILJEQVIST.—In connection with this deposition of Mr. Richardson which has been referred to, there is an offer in evidence of the same chapter, of the same pages of the book, and we repeat the offer in evidence of that part.

Mr. LYMAN.—That is objected to, if the Court please, for the same reason.

The COURT.—And the objection is sustained, I don't think the statement made by the witness in that regard is competent.

Mr. LILJEQVIST.—Would counsel permit us to withdraw one of the books and let the one cover the same thing?

Mr. LYMAN.—Yes.

Mr. MONTAGUE.—Did you offer that book in evidence as an exhibit?

Mr. LILJEQVIST.—The specified pages referred to in the Upham deposition, the same pages are referred to in the deposition of Richardson.

Mr. MONTAGUE.—That is your Exhibit "X." And will you kindly give me the pages? [876—332]

Mr. LILJEQVIST.—I think it is pages 375 to 388, inclusive, and we repeat that offer in connection with Clifford Richardson's deposition. May it please the Court, we offer in evidence—

Mr. MONTAGUE.—(Interrupting.) That is for identification only, isn't it? That is Exhibit "X" for identification.

Mr. LILJEQVIST.—No, we are offering it in evidence, and I understand the Court refuses the offer.

The COURT.—Yes, it has been excluded.

Mr. LILJEQVIST.—And we are saving an exception and we offer it in evidence under the statute, that is, under the equity rule.

(Deposition of C. B. Hunt.)

Mr. MONTAGUE.—It could only be called "for identification."

Mr. LILJEQVIST.—No, we offer it in evidence and I think it may be admitted subject to the—

The COURT.—(Interrupting.) Well, it is a matter that is not material what form it takes so that it is identified. [877—333]

Counsel for defendant at this point read the deposition of C. B. HUNT, taken on deposition at Washington, D. C., April 28, 1922, as follows:

Deposition of C. B. Hunt, for Defendant.

Direct Examination.

(By GIBBS L. BAKER, Washington, D. C.)

Mr. Hunt testified his residence was 1316 New Hampshire Avenue, Washington, D. C.; that his position is Engineer of Highways, District of Columbia. He has occupied that position since 1897. For a few years before that he was Engineer of Bridges of the District of Columbia, which is an office subordinate to the Engineer of Highways, in the same department, and before that he was Assistant Engineer back to 1890. That is when he entered the service of the District. He is familiar with the various pavements laid throughout the city of Washington; they are under his charge and have been for 23 years. Asked if he could tell the history of the pavement of Vermont Avenue from H Street to I Street he stated he could not remember the dates accurately enough to swear to them. They are very old pavements. He can

(Deposition of C. B. Hunt.)

probably answer any specific questions about the matter. It was a good pavement in 1890. It is a coal-tar pavement. It is quite a notable pavement in the history of pavements. You will find it referred to in the literature of asphalt pavements. For a short description of this street he must refer to the card history which he cannot produce himself but which will be produced by another witness. (The witness was handed a record of pavements on Vermont Avenue between H and I.) The record indicates that the body of the pavement as it is there now was laid about 1870. It reads: "Vermont, northwest from H to I. Laid about 1870. (Objected to on the ground that the record is the best evidence.) Character: Scharf [878—334] coal-tar. Total square yards 4156. Act proved September 7, 1869. Laid by old Corporation. Probably Scharf contractor. Resurfaced 1880 by Cranford & Hoffman, asphalt surface." There is a good deal of detail about the patching of the surface.

Copy of record Card of Vermont Avenue N.W. from H to I was offered and received in evidence and marked Defendant's Exhibit "1 Vermont Av. N.W."

This card has been in his office a great many years. He does not know the exact date it was made, at least ten or fifteen years and is compiled from a book which witness had before him as original basis which is entitled "The History of Concrete Pavements in the Engineer Department of the District

(Deposition of C. B. Hunt.)

of Columbia." The information contained on the card Defendant's Exhibit "1 Vermont Ave. N.W." is found on page 551, with a tag on the page, Vermont Avenue. Information on that page is the same as that quoted from the card. He imagines it is the same for all the rest. On comparing the card and book he stated the matter submitted as Defendant's Exhibit "1 Vermont Av. N.W." agrees with the book as to the location of the pavement, its character, area, contractor and the date of resurfacing. The book describes the cost of repairs up to 1909. The card contains record of repairs from 1910 on; otherwise the comparison shows them alike.

A copy of page 551 of this book was produced and offered in evidence and marked Defendant's Exhibit "2 History of Concrete Pavement Engineering Department, D. C." [879—335]

The book from which this exhibit was taken is part of the records of Mr. Hunt's office, and contains a record of all asphalt pavements, coal-tar pavements, with limits and areas and the base of construction, resurfacing and repairs in the District of Columbia. He does not know whether the book was in existence when he came into the employ of the city in 1890 but he is sure that it was there at the time he became Engineer of Highways in 1897. The resurfacing of Vermont Avenue, which is referred to in Defendant's Exhibits 1 and 2, had taken place before he became an employee of the city in 1890. Did not observe or be-

(Deposition of C. B. Hunt.)

come conscious that the pavement had been resurfaced at the time he became an employee of the city. The pavement was there but the resurfacing is a matter of history as disclosed by the records so far as he is concerned. Thomas Circle is at Fourteenth Street. There are two roadways in there between Fourteenth and Fifteenth; a main roadway and a terrace. The main roadway on Massachusetts Avenue between Fourteenth and Fifteenth is referred to on Page 491 of the "History of Asphalt Pavements of the District of Columbia," which page the witness produces.

Page 491 is produced by the witness and a copy of the same is offered in evidence as Defendant's Exhibit "3 Mass. Ave. between 14th and 15th."

Witness has record card compiled from that page which he produces. These cards are the history of the pavements, as described in this book, was kept in this book many years in the form disclosed by copies that are submitted, and for more convenient, and, I think, better records, the system was changed from a book record to card record, the date that is [880—336] found on the card identifying the item in the book, and the record of repairs after the cards were compiled was continued by the cards and omitted from the book. In other words, one is supplemental in a way to the other.

The card is offered and received in evidence as Defendant's Exhibit "4 Mass. Av."

Mr. Hunt produced a card record of Pennsylvania

(Deposition of C. B. Hunt.)

Avenue N. W., north side from Washington Circle to Twenty-sixth Street.

A copy of such card record was offered and received in evidence as Defendant's Exhibit "5, Penn. Ave. N. W."

The matter is transcribed from page 530 of the "History of Concrete Pavements" above referred to.

A copy of which page is offered in evidence as Defendant's Exhibit "6 Penn. Ave. from History of Concrete pavements."

Witness produces copies of the statement of account, including the drawings, in regard to the last resurfacing, done on the portions of Vermont Avenue, Massachusetts and Pennsylvania Avenues, to which he had testified, together with the recapitulation of the contract.

A copy of the page as to Vermont Avenue was offered in evidence and marked Defendant's Exhibit "7 Vermont Avenue"; as to Massachusetts Avenue marked Defendant's Exhibit "8 Mass. Avenue"; as to Pennsylvania Avenue marked Defendant's Exhibit "9 Penn. Ave." [881—337]

Cross-examination.

(By Mr. LYMAN.)

Witness only knows of the construction of the pavement referred to by him on Vermont Avenue, Massachusetts Avenue and Pennsylvania Avenue from records of his office. They were all made before he was Engineer of Highways. Knows how the pavements were constructed only as the records

(Deposition of C. B. Hunt.)
of his office show. He has no personal knowledge of the construction from observation during the process. Knows only as to the repairs on these streets as they were done by employees of the office. Undoubtedly must have seen repairs as they were made. Cannot remember the specific instances. Cannot remember under what contracts either of those street pavements were laid. Can easily furnish information. A man does not carry those things in his mind. Cannot tell whether he can produce the original contracts or not because he has to look in the records of his office. Can tell by whom the pavements were originally laid by the record and as the record book shows. Reading from the record book, Vermont Avenue from H to I shows contractor entered in the book is Old Corporation, Scharf, under the head of remarks, and the date is 1869. Laid under Act approved September 7, 1899. The same is repeated in the record card. As to Massachusetts Avenue from Fourteenth to Fifteenth the original square, that is part of a total between Fourteenth and Twentieth which was carried as a unit in the record. It refers to the main street. The [882—338] record book states that it was laid in 1873 by C. H. Evans. The card repeats the statement; coal-tar pavement. North side of Pennsylvania Avenue from Twenty-third to Twenty-sixth is a unit carried in the record book and on the card. The book shows it was laid in 1877 by W. C. Murdock, Contractor, Coal-tar on concrete base. The card uses the same words in its description. On the card Mr. Bailey has written

(Deposition of C. B. Hunt.)

the word "Scharf" in addition to the book record. Mr. Bailey, being my predecessor in office and in charge of street pavements up to 1897, and after that being my assistant in the office and the compiler of these cards until the date of his death. Does not personally know whether he can produce either of the contracts under which either of those pavements were laid. The contracts ought to be in his possession or in the possession of his office and he could answer if he had them. Has access to them if they can be found and will produce them if able and notify the Commissioner as to these three items which he is talking about. Witness thinks Mr. Dare or Mr. Beall will know more about the whereabouts or the accessibility of these contracts than he does. The name of the book from which he has been quoting is "History of Concrete Pavements, Engineer Department, D. C," and he found the book in existence as a living record in his office when he became Engineer of Highways and his predecessor in office was George H. Bailey. This book was on his desk at all times. On the first page of the book is an entry in his handwriting and throughout the book his handwriting appears, and he was my predecessor for a great many years. The cards which took its place were devised as a more convenient form than the book; the book was getting rather full in places and the cards were more convenient, and they had the same [883—339] history and Mr. Bailey kept them up. Witness did not personally keep any portion of the record referred to, nor any of the entries are in

(Deposition of C. B. Hunt.)

his handwriting. The record discloses the exact repairs that have been made, and the extent of them on the three coal-tar pavements referred to. It is not witness' remembrance that these pavements practically went to pieces and were relaid. With reference to whether Vermont Avenue was laid under a patent, in the record it shows "Scharf, 1869." There are no other words. Does not know whether Scharf had a patent for street pavement at that time. Has always heard of the Scharf patent but knows nothing about it. Does not know whether Murdock had a patent for the pavement. With reference to whether Massachusetts Avenue from Fourteenth to Fifteenth was laid under a patent, the book item of Fourteenth to Twentieth shows as laid by C. W. Evans. In the remarks column is the word quoting "Evans." Pennsylvania Avenue from Twenty-third to Twenty-sixth north side, by W. C. Murdock. In addition to the book record the card has an entry on it, under the word character "Coal-tar, Scharf." Finds no reference to Snow and Davis or their patent, with reference to the pavement laid on Massachusetts Avenue by C. E. Evans. Does not know whether the contract would show whether it was laid under such patent. Has no other record in the office with reference to the construction of these pavements, unless he can discover the contracts, which he will search for. Will examine the records to ascertain if there is a book called "History of pavements of the District [884—340] of Columbia." Will produce it if found. These records, before he went

(Deposition of C. B. Hunt.)

into office, were in the custody of the official which he happens to be at present. His predecessor was George H. Bailey, who died about five years ago, a very old man. He was custodian of the records. Much of the book is in his handwriting—a very characteristic handwriting.

(After recess Mr. Hunt returns and testifies:)

That he found a book which he believes is the one that was referred to and which he did not have with him, and which he produces. On the front there is an inscription by pasting a sheet of paper on the open cover, reading as follows: "Office of the Engineer Commissioner, Washington, D. C., March 24, 1882. This book contains the date, number of contract, name of contractor, amount and cost of each piece of pavement laid in Washington and Georgetown, from 1870 to the present time. It was compiled from the vouchers and measurements of the Board of Public Works, First Board of Commissioners (1874 to 1878), and permanent Board of Commissioners (1878 to the present time). Prior to 1878 the cost given includes pavement only. Since that date the cost includes incidental and extra work such as grading, curb setting, sidewalks, etc. The price per square yard for pavement alone is given in every case. F. W. Greene, 1st Lieutenant of Engineers." On page 541 of this book is a reference to Massachusetts Avenue, Twentieth to Fourteenth.

A copy of this page 541 is received in evidence and marked Defendant's Exhibit "10 Mass. Ave."

(Deposition of C. B. Hunt.)

In the same book on page 584 there is a reference [885—341] to Pennsylvania Avenue from Twenty-third to Twenty-sixth.

A copy of this page 584 is received in evidence and marked Defendant's Exhibit "11 Penn Ave."

On page 613 of the same book is an item on Vermont Avenue to which this page is devoted, "Original Pavement H to I—Scharff, Concrete."

A copy of this page 613 is received in evidence and marked Defendant's Exhibit "12 Vermont Avenue."

Did not find copies of the contracts under which any of these three pavements were laid. Did the best he could to find them. Asked those to whom he could apply and had no success. Did not inquire at the Auditor's Office, which is not the place, as he understands, where they would be, although they may be there. There is a record office in the engineering department and it is to that office that they go for all their contracts and the copies are kept there. Whether in the past that is the rule or not he does not know. The auditor is not in his department. Opening the book at page 156 the entry at the top of the page reads as follows: "Concrete. Evans. Letters patent No. 81,698." Those figures have been changed. There is something written above—"1868, Snow and Davis" and underneath "96,988 of 1869, Snow and Davis." Witness cannot interpret that entry. Fourteenth to Twentieth was the item "Massachusetts Avenue, 14th to 20th."

(Deposition of C. B. Hunt.)

A copy of the page 156 is received in evidence as Defendant's Exhibit "13, Concrete."

Witness finds on page 157, in the middle of the page, an entry in respect to Massachusetts Avenue from 14th to the Circle, including the elevated road. [886—342]

A copy of page 157 is received in evidence marked Defendant's Exhibit "14, Evans Pavement."

Massachusetts Avenue from Fourteenth to the Circle does not describe at all the limits of Massachusetts Avenue from Fourteenth to Twentieth Streets. The Circle is at 14th Street. Page 162 of the book referred to is headed "Concrete, Filbert Vulcanite, Letters Patent No. 108,696 of 1870."

A copy of page 162 is received in evidence marked Defendant's Exhibit "15 Filbert Vulcanite."

Witness is unable to find the contracts.

Copies of pages 158 and 159 of this book were headed "Concrete" and then underneath the word "Scharff, letters patent No. 111,151 of 1871."

Pages 158 and 159 were received in evidence marked Defendant's Exhibit "16 Scharf."

The first item on the page relates to Vermont Avenue, H to I Streets, and the entries go on to say that this pavement "was laid by the Old Corporation"; number of square yards being 4156; that it was resurfaced in 1875 and 1879; that the name of the contractor was W. C. Murdock. That seems to be a resurfacing contractor. Identifies it by the apostrophe 75 date there. Murdock was a resurfacing contractor in 1875.

(Deposition of C. B. Hunt.)

Mr. LYMAN.—I have here photostatic copies of all the exhibits put in evidence during the course of this deposition which I will now ask the examiner to mark for identification.

It is stipulated that these photostatic copies have been compared with the originals and are correct. These photostatic copies are marked as follows: "Warren Brothers Company against Oskar Huber, for identification, exhibits No. 1 to 16, inclusive, Washington, D. C., April 28, 1922, R. L. Whitman."

It is the practice of Mr. Hunt's department in resurfacing streets with sheet asphalt to put on what is called a binder course and then sheet asphalt on top of this. Cannot tell whether that was the practice in the early days. Does not know whether there was any litigation over the so-called Evans pavements. [887—343]

Redirect Examination.

(By Mr. BAKER.)

The book above referred to with the inscription on the front page reading "Office of the Engineer Commissioner, Washington, D. C., March 24, 1882," etc., was a part of the record of the District of Columbia relating to street paving. Mr. Hunt is very familiar with the handwriting of Mr. Bailey and the book is made up in his handwriting. At the time of the creation of this book and down to the time Mr. Hunt became Engineer of Highways the book was kept by Mr. Bailey as the officer in charge and from that date until the termination of

(Deposition of C. B. Hunt.)

Mr. Bailey's services with the District he continued to keep it as a subordinate. The book called "History of Concrete Pavements of the District of Columbia" was one of the original records of the District of Columbia and up to 1910 was a book of original entry and Defendant's Exhibits numbers 1, 4 and 5, above referred to, were made up from this book of original entry. After 1910 the book was discontinued and the card system substituted. The continuing record was kept on the cards.

Counsel for defendant at this point read the testimony of JOSEPH W. DARE, taken on deposition at Washington, D. C., April 28, 1922, as follows:

Deposition of Joseph W. Dare, for Defendant.

Direct Examination.

(By GIBBS L. BAKER, Washington, D. C.)

Joseph W. Dare testified he was sixty-seven years of age; that his occupation is Civil Engineer; is employed by the District of Columbia. Has been employed by the District of Columbia over forty years; forty years last February; since February, 1882. His first occupation for the city was a rodman in the field work. His work at the present time covers [888—344] making plans and estimates and superintending construction of streets, establishing grades, and practically all the engineering work in connection with the building of streets. He remembers the pavement on Vermont Avenue, between H

(Deposition of Joseph W. Dare.)

and I. As he remembers that street was paved when he first came in the employ of the city. It was what was called then a concrete pavement; it was known as a concrete pavement then. Doesn't know what it was made of nor what was the cement medium. The records show that that pavement was resurfaced while he was in the employ of the city; he doesn't know anything about it. He remembers the pavement on Massachusetts Avenue between Fourteenth and Fifteenth Streets and thinks that street was paved at the time he came in the employ of the city. That was a pavement of about the same character. They called it a concrete pavement. Also remembers the pavement on Pennsylvania Avenue between Twenty-fifth and Twenty-sixth Streets, Northwest, north side, and thinks that pavement was in existence when he came to the city. It was about the same character of pavement. Vermont Avenue, Massachusetts Avenue and Pennsylvania Avenues at the places referred to were called concrete pavements—a bituminous concrete.

Cross-examination.

(By Mr. LYMAN.)

So far as Massachusetts Avenue is concerned, he knows that that was a bituminous concrete pavement because he resurfaced that and knows when the pavement was cut out that it was what they call a bituminous pavement. All these pavements were laid before he came into office. He had nothing to do [889—345] with the preparation of the

(Deposition of Joseph W. Dare.)

material, or the specifications under which the pavements were laid. Knows nothing about that. Does not know about the sidewalks. Bituminous concrete is made of some form of bitumen and stone and sand.

Redirect Examination.

(By Mr. BAKER.)

With reference to Massachusetts Avenue between Fourteenth and Fifteenth, the main street, in resurfacing the surface was placed on top of the old pavement, except where they cut out the old pavement two feet next to the curb to put in a vitrified block gutter. That strip was taken out next to the curb but the balance of the street roadway was covered with a new surface. The resurfacing material consisted of a binder and asphalt top.

Recross-examination.

(By Mr. LYMAN.)

Witness thinks these pavements on Vermont Avenue, Massachusetts Avenue and Pennsylvania Avenue have not all gone to pieces from the original construction and have not been relaid but they have been resurfaced. Thinks they have been resurfaced once. Does not know anything about any trouble in the original construction or if it was tied up in litigation. The records show that they have only been resurfaced once and witness knows that Massachusetts Avenue has only been resurfaced once. By records he does not refer to the "History of Pavements in the District of Colum-

(Deposition of Joseph W. Dare.)

bia'' but refers to these records and those cards and measuring sheets that he thinks are brought up from this history of asphalt pavement. They [890—346] are compiled from this history of the asphalt business. Witness thinks the history of the asphalt pavements probably will not show the resurfacing of either Massachusetts Avenue or Pennsylvania Avenue. Thinks the history of the asphalt pavements was discontinued in that form in that book when those two streets were resurfaced. The witness actually saw Massachusetts Avenue between Fourteenth and Fifteenth Streets undergoing resurfacing. Doesn't remember the date, sometime in the 1900's. The records will show the date. Binder course and an asphalt top, asphalt surface was used in that resurfacing. The binder course was asphalt binder. The binder course was made of stones and asphalt cement, and on top of it a layer of ordinary sheet asphalt. The sheet asphalt is laid two and half inches loose and the specifications require it to be at least an inch and a half thick after compression. The binder course varies with the kind of work; they lay it three inches deep in some places and an inch in others as may be necessary to bring the old pavement to a grade and then top it on. There is no place that witness knows of where any of these pavements can be found in the original condition. Has not had anything personally to do with the making of these records that have been produced.

Counsel for defendant at this point read the

(Deposition of George W. Beall.)

testimony of GEORGE W. BEALL taken on deposition at Washington, D. C., April 28, 1922, as follows:

Deposition of George W. Beall, for Defendant.

Direct Examination.

(By GIBBS L. BAKER, Washington, D. C.)

Witness stated his name is George W. Beall; that he is about seventy-two years of age, was born in 1850; his [891—347] occupation is Inspector of Repairs to Asphalt Pavements, District of Columbia; his residence is Beltsville, Maryland. Has been an employee of the District of Columbia thirty-three years. Entered the employ of the District in 1889, as rod man, Engineer Department, field work. He assisted Mr. Charles A. Mullen to obtain some samples of pavement of the city on or about the 27th day of July, 1920. He met Mr. Mullen and was instructed from their office, Mr. C. B. Hunt, to go with Mr. Mullen and secure these samples at the places indicated, which were Vermont Avenue between H and I and they marked out those samples together. Thinks they marked those right in front of the War Risk public entrance. Also on Massachusetts Avenue between Fourteenth and Fifteenth; and Pennsylvania Avenue, north side between Twenty-fifth and Twenty-sixth. The samples were collected by Mr. Mullen and the witness. They were about two feet square and as thick as whatever the pavement was, to the earth, the full thickness. A man named

(Deposition of George W. Beall.)

Johnson, colored, and another man named Camphor cut these samples. Vermont Avenue was very much the thicker pavement of the samples. Does not remember the thickness exactly. No identification marks placed on the samples. The samples were delivered to the District Property Yard, 1st and Canal Streets, to Mr. Johnson, who has charge of that yard. Vermont Avenue between H and I Streets, northwest was paved when he first came in the employ of the city. It was what was called a tar pavement at that time; bituminous base pavement, stones that were tarred and rolled in. Does not remember the preparation for the surface. Massachusetts Avenue between Fourteenth and Fifteenth Streets, northwest was paved at the time he came into the employ of the District. [892—348] The character of the pavement was practically the same; they called that bituminous pavement. Massachusetts Avenue between Fourteenth and Fifteenth, northwest, has been resurfaced, since witness has been with the city. The nature of the surface was a preparation of binder and sheet asphalt for surface. The old pavement was not taken up. It was resurfaced over the tar. At the time witness came in the employ of the city, Pennsylvania Avenue between Twenty-fifth and Twenty-sixth Streets, northwest, north side was paved; the character was practically the same—tar, what they called bituminous in those days.

(Deposition of George W. Beall.)

Cross-examination.

(By Mr. LYMAN.)

Pennsylvania Avenue has been pretty well patched but the original is very much in evidence to anybody who is familiar with it. Vermont Avenue is not patched to the same extent. Vermont Avenue's difficulty is crowding, they call it, pushing; Vermont Avenue does not wear in holes. They have different versions of the reason for the pushing. The chemists have varied reasons, and witness thinks one cause might be its getting oily and soft in the summer; then it gets a constant thumping by automobiles and trucks and since the war the heavy automobiles and heavy trucks especially. There is no pushing at all on Massachusetts Avenue between Fourteenth and Fifteenth; that is not fine; pushing is naturally where you have a fine material. That is in the asphalt surface. The difference in that and the Pennsylvania Avenue pavement is that the Pennsylvania Avenue pavement simply wears gradually; it just gets little holes in it but the original surface is still intact there with that exception. By "original surface" he means the original surface of the pavement when laid. He first saw Pennsylvania [893—349] Avenue about 1890. In 1890 he was appointed to the work of repairing the asphalt pavements. Pennsylvania Avenue has never been resurfaced to witness' knowledge, with the exception of some little parts around Twenty-sixth Street. When Mr. Dare resurfaced Twenty-sixth Street he came

(Deposition of George W. Beall.)

around in the avenue then a little; the joint is very marked; anybody can see that; but when you go up to Twenty-fifth Street you will notice the original pavement. It was not resurfaced between Twenty-fifth and Twenty-sixth Streets. He means that when Twenty-sixth Street was resurfaced from M Street up to the Avenue, in order to get a good grade, Mr. Dare went around possibly twenty-five feet with the asphalt. The stretch on Pennsylvania Avenue between Twenty-third and Twenty-sixth has never been resurfaced to the witness' knowledge, except just where it joined Twenty-sixth Street, and there is a little place resurfaced when Mr. Dare resurfaced around Washington Circle he went down there north to Twenty-fourth Street. He can show the joints there plain when Mr. Dare came on around. Does not mean that that resurfacing went from Twenty-sixth Street to Twenty-fourth Street.

Redirect Examination.

(By Mr. BAKER.)

He remembers the samples he took from Pennsylvania Avenue with Mr. Mullen, also the location of it. The sample taken from a part of Pennsylvania Avenue was as being in the original condition and not having been resurfaced. [894—350]

By stipulation the testimony of STEPHEN CAMPHOR, colored, and A. ALEXANDER JOHNSON, colored, taken in the case of Bitulithic Pav-

(Deposition of Stephen Camphor.)

ing Company, Limited, and Warren Brothers Company, Plaintiffs, vs. The City of Montreal, Defendant, was read in evidence as follows:

Deposition of Stephen Camphor, for Defendant.

Direct Examination of STEPHEN CAMPHOR.

(By GIBBS L. BAKER, Washington, D. C.)

Witness remembers digging up some samples of pavement on or about the 27th day of July, 1920, for Mr. Mullen. Those samples were dug from Vermont Avenue between Fifteenth and Sixteenth Streets, in front of a big hotel or apartment. Also on Massachusetts Avenue and Pennsylvania Avenue near the Georgetown Bridge where the cars go. He dug those samples off in four squares, clear down to the ground. Through the entire pavement right down to the dirt. Mr. Mullen marked the samples, they were marked with a piece of crayon.

Cross-examination.

(By Mr. LYMAN.)

He first saw Mr. Mullen on that job. He had seen him before but he could not place him. He had seen him a good many years ago but witness never placed him before he met him and got to talking with him on the job, and then he recognized Mr. Mullen. Mr. Mullen marked the place from where witness dug the samples. He dug them wherever Mr. Mullen told him to. The samples were two feet square or a little over. He dug the samples clear through the pavement foundation, right straight down to the dirt. He loaded

(Deposition of Stephen Camphor.)

them on the wagon, where he dug them up, and then witness went back to work. The samples looked to the witness as being about two feet thick, they might have been more. He never took direct note of it. [895—351]

Deposition of A. Alexander Johnson, for Defendant.

Direct Examination of A. ALEXANDER JOHNSON.

(By GIBBS L. BAKER, Washington, D. C.)

Witness was working for the District of Columbia in the month of July, last. On or about the 27th day of July, 1920, witness cut certain samples of pavement for Mr. Mullen. They cut a couple of samples out on Fifteenth and H; on Vermont Avenue; on Massachusetts Avenue; and Pennsylvania Avenue. Stephen Camphor worked with witness in cutting these samples out. Doesn't know who marked them. They were marked out when witness came to the job. Thinks there was an identification mark put on the samples after they were cut. If he is not mistaken the marks were put on the samples after they were cut.

Cross-examination.

By Mr. LYMAN.—Witness cut one of these samples at Fifteenth and H Street.

Mr. LYMAN.—There were a variety of exhibits attached to those depositions,—drawings and plans and extracts from the books and records of the District of Columbia—which will show just when

(Testimony of F. C. Blake.)

those pavements were laid, and who laid them, and so on, and how much—

The COURT.—(Interrupting.) They are attached to the depositions?

Mr. LYMAN.—Whether they are attached physically to the depositions, I don't know.

Mr. LILJEQVIST.—Yes, they are.

Mr. LYMAN.—They are bound in, are they?

Mr. LILJEQVIST.—Yes. We offer them in evidence. I suppose they are in as they are.

Mr. LYMAN.—I want to be sure that they are in evidence in this case.

The COURT.—Yes, they are.

Testimony of F. C. Blake, for Defendant (Recalled).

F. C. BLAKE was thereupon recalled as a witness in behalf of defendant herein, and, having been previously sworn, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

Asked by counsel to state, in reference to the original pavement back of McGovern's undertaking establishment, what has been done with that original pavement from the time witness first saw it as the years have gone by he stated; there has been a great number of samples removed from that old piece of pavement. There is also a public service cut run through the alley, all of which has had to be repaired; the public service [896—352] cut was repaired by having a concrete foundation put in over the old cut and then repaired with a sheet asphalt,

(Testimony of F. C. Blake.)

then the sheet asphalt mixture; then the holes where the various pieces of pavement have been removed have been patched with, in some cases, binder, he believes, and, in other cases, heavy sheet asphalt wearing surface. In repairing the holes the attempt was evidently just to repair the hole alone but recently he was looking at that very carefully and he noticed that where he took out a former sample in 1909, had been repaired, and it had evidently settled and they had put a skin patch over the top again, and the result was that there was a considerable area around that immediate patch had been sort of skin patched over the top, so as to raise it up. With a standard sheet asphalt mixture. It has considerably altered the whole appearance. It is only here and there that you can see, due to the fact of this mixture that has been put on; they shoveled the material out of a wagon or truck, usually, and let it fall onto the old pavement, then the rakers put it into the hole and tamped it down, and the mixture will appear between the area immediately surrounding these patches, and the smoothing irons run over it will warm it up sufficiently to make it adhere to the original pavement. The first sample was taken out in about 1904. Cannot say if there was any change in the condition of that pavement up until that time. Witness took his sample out in 1909, and the only place at that time that was apparent that there had been any repair work done was the point through the central area of the alley where

(Testimony of F. C. Blake.)

the public service cut had been, and at a place where there had been a former sample taken out. [897—353]

Cross-examination.

(By Mr. LYMAN.)

Asked who it was that took this sample out in 1904, Mr. Blake testified he had met who it was that told him that they had removed that sample, but doesn't recall now just who it was. He met them first in Cincinnati; met them in different parts of the country. It was some working man, some laborer, doesn't recall who it was. Doesn't know if he took the sample out for the Barber Asphalt Paving Company. He had worked for the Barber Asphalt Company but witness believes the sample was taken out to be sent to Cincinnati at the time of some controversy there between the Warren Company and witness' father. The sample was sent to Cincinnati. There was a controversy on in 1904 or early part of 1905 with the Warren Company.

Redirect Examination.

(By Mr. LILJEQVIST.)

The sample was not turned over to his father or to any of their people. Doesn't know who got it. That hasn't been within my definite knowledge. A former man who was in a prominent position with the Warren Brothers Company told witness what became of that sample.

Mr. LYMAN.—(Interrupting.) Are you trying

(Testimony of F. C. Blake.)

to say that that sample ever was in the possession of Warren Brothers Company?

Mr. LILJEQVIST.—Well, if we could allow this witness—

Mr. LYMAN.—(Interrupting.) Well, I would like to run that down. I would like to find the sample, if there ever was one.

A. You will find it in the bottom of the Ohio river; I understand it was thrown over the bridge.

Mr. LYMAN.—Well, now, do you know that personally?

A. That was told to me by Mr. McEnerney.

Mr. LYMAN.—By whom?

A. By P. J. McEnerney, Warren Brothers' representative in Cincinnati at that time.

Mr. LYMAN.—That is hearsay, if your Honor please, and I ask that it be stricken out.

The COURT.—Yes, that would not be competent.

Mr. LYMAN.—Such scandalous slander as that should be proved or not suggested. That is all. [898—354]

Counsel for defendant at this point read the testimony of SAMUEL D. CRAGO, which was taken on deposition before Clarence A. Williams, at Pittsburg, Pa., on May 1, 1922, as follows:

Deposition of Samuel D. Crago, for Defendant.

Direct Examination.

(By JOHN H. RONEY, Pittsburgh.)

Name of witness is Samuel D. Crago, age 52, residence, Forest Hill Borough, Pa., a real estate salesman. He was employed by Booth & Flinn, Ltd., in the construction of roadways for nineteen years up to November 1st, 1915. During this time he was familiar with the so-called asphalt or bitulithic pavements. Bitulithic concrete or bitulithic pavements were put down by Booth & Flinn, Ltd. in Bellefield Avenue in 1896; North Lang Avenue and North Hiland Avenue, and Mr. Roney has a sample from Bond Street or St. Marie St. about 1896 or previous to that. Witness has a list of all the streets if it is wanted. His position with the firm of Booth & Flinn was that of Assistant Superintendent. He was on some of these streets at the time they were constructed. In 1915 samples were taken from some of these streets to show the composition. At that time there was a suit against Booth & Flinn. Some of these samples are here in the office as he knows the identification marks. He placed two of such marks himself. There is one marked "Bellefield Ave., 1896." He can identify these two specimens from reference letters which he placed on them. He believes Bellefield Avenue was put down originally in 1896. It is marked on the sample. Lang Avenue from Penn Avenue northward was put down in 1893. The specimen [899—355]

(Deposition of Samuel D. Crago.)

which he identifies was taken from Lang Avenue northward from Penn.

Q. 17. I direct your attention to two large specimens in the box, will you please look at those and see whether or not you can identify them?

By Mr. LYMAN.—Objection. It is understood Mr. Roney, that the objection is on the grounds that there is no foundation laid for it in the Answer in this case.

On the big ones, there isn't any mark of witness on them. Mr. Reddy and Mr. Beck, 1916. That was taken afterwards. There isn't any there that witness marked personally, but he knows they did take a sample from North Hiland Avenue and St. Marie St. Mr. Crago made an affidavit relating to this subject matter at the time the suit was pending between Warren Brothers Co. and Booth & Flinn.

By Mr. RONEY.—Now, Mr. Lyman, I want to offer in evidence, a copy, not the copy of record in our Court here, but a compared copy of that affidavit, just to refresh his memory.

Witness is shown compared copy of an affidavit to refresh his memory which was signed by him in the case of Warren Brothers vs. Booth & Flinn, Ltd. and after examining the same stated that he believed the sample which he then indicated to be the sample taken from St. Marie Street on June 15th. He identifies it as having a shipping tag of Booth & Flinn pasted on it, which contains the

(Deposition of Samuel D. Crago.)

marking "St. Marie St. 36 feet east of North Hiland Avenue." [900—356]

By Mr. RONEY.—The specimens referred to by the witness are offered in evidence and marked "Defendant's Exhibit, St. Marie St." A. Crago, May 8, 1922. "Defendant's Exhibit, Bellefield Avenue B" Crago, May 8, 1922. "Defendant's Exhibit Lang Avenue L" Crago, May 8, 1922.

By Mr. LYMAN.—Same objection to the samples as on the grounds no basis laid for it in the Answer in this case.

By Mr. RONEY.—Counsel for the Defendant also offers in evidence the affidavit made by the present witness in the case of Warren Brothers vs. County of Allegheny, et al., No. 37 November Term, 1915, in the District Court, Western District of Pennsylvania, and marks the same "Defendant's Exhibit Crago Affidavit." This affidavit is offered in evidence for the purpose of showing that the present witness removed from various streets in the City of Pittsburgh, portions thereof, to show the construction thereof, and for the purpose of showing that the witness' memory has been refreshed by reference to this affidavit.

By Mr. LYMAN.—The affidavit is objected to as inadmissible the witness being here present.

By Mr. RONEY.—Counsel for Defendant directs attention to the fact that the witness is present, and is open for cross-examination on the facts stated in this affidavit, on his present deposition. It is understood that a compared copy of said affi-

(Deposition of Samuel D. Crago.)

davit will be admissible instead of a certified copy thereof.

Mr. LYMAN.—Objected to as the matter is not referred to in the Answer in this case and is a self-serving declaration. [901—357]

Bond St. or St. Marie St. was laid in 1897. Witness made an analysis of the constituent parts of some of these various streets. He remembers making one on Lang Avenue and one on Bellefield Avenue. Witness produces a copy of an analysis of Bellefield Avenue and stated William L. Beck and witness made the analysis. This is an analysis of Bellefield Avenue. Piece of this Bellefield Avenue sample, identified as "B Bellefield Ave. 1896"—not that particular piece, but a piece broken off of it.

By Mr. RONEY.—Counsel for the defendant offers in evidence this paper which has been submitted to the witness and marks same "Analysis of Bellefield Ave. Specimen B."

Mr. LYMAN.—Objected to as hearsay.

At Booth & Flinn's laboratory, asphalt plant, they analyzed it in 1915. At the time the analysis was made, Mr. Beck was Superintendent of the asphalt plant. He assisted in making this analysis; he and the witness jointly made the analysis. Counsel hands witness a paper and he states this purports to be an analysis of St. Marie or Bond Street. Stated this was not attached to the affidavit. Thinks Mr. Beck made the analysis, but the handwriting. Is not positive, although he knows they

(Deposition of Samuel D. Crago.)

did make the analysis of the sample they took from there. All those analyses he and Mr. Beck made jointly.

By Mr. RONEY.—The paper is offered in evidence as "Analysis of the Sample of St. Marie St." heretofore mentioned by the witness.

By Mr. LYMAN.—Objected to as hearsay in addition to the grounds previously noted.

They dissolved the sample into its constituent [902—358] parts and tested it for voids, used the sieve test, got different proportions of it, etc. Witness was present at the time Mr. Beck and he made these analyses. They went through the usual process of dissolving the sample into its original elements, got the mineral aggregate, used the sieve test on it.

By Mr. RONEY.—Counsel for defendant offers in evidence paper submitted to the witness and marks the same "Defendant's Exhibit Analysis St. Marie St. Formerly Bond St."

By Mr. LYMAN.—Objected to as hearsay in addition to the other grounds on objections previously noted.

Witness has a list of all the streets laid by Booth & Flinn, but they are not in his mind. Mr. Crago refers to his memorandum and finds Elgin Avenue, Highland to Mellon, was laid by Booth & Flinn, in 1892. Counsel hands witness a paper and witness stated this purports to be the analysis of the Elgin St. pavement laid in 1892, and the street was laid before witness was connected with Booth & Flinn.

(Deposition of Samuel D. Crago.)

The sample was taken in 1915. Copy of the analysis is in Mr. Beck's handwriting. He and witness made the analysis.

By Mr. RONEY.—The paper is offered in evidence and marked "Defendant's Exhibit Analysis of Elgin Street Pavement."

By Mr. LYMAN.—Objection same as above noted. [903—359]

Cross-examination.

(By Mr. LYMAN.)

Asked to explain the different results in the analyses, he stated there was some difference in the samples taken. It would not necessarily be due to the difference in the wear on the streets. These samples were taken from portions of the street where there would not be so much wear, for instance, near the side of the street.

XQ. 3. Is it a fact that the streets covered by the analyses have been subjected to different degrees of wear, so that the wearing surface had been worn away more in some cases than in the other which accounts for the difference in the analysis?

A. I think I answered that.

XQ. 4. Do you mean then to say no to that question.

A. I believe that the question could not be answered by yes or no.

In the first place, there isn't a very wide difference in the analyses of the streets, further it was the object in taking the sample to get a typical sample of the street. Any practical person would know

(Deposition of Samuel D. Crago.)

that there is some variation of laying streets under the same specifications during the present day of all improvements. There are cases where it will be worn off at the surface, and probably show thin—there would be more voids because the finer material would be worn off at the top. Some of these streets were laid before witness had any connection with Booth & Flinn; Elgin Street was one of them. Asked if they were laid under the same specifications, witness stated he had no personal knowledge. Counsel asks for the memorandum [904—360] which witness has been using to refresh his recollection but witness stated it was private memorandum from the records of Booth & Flinn; it is a private record so far as they and witness is concerned. It dates back to the time he was connected with them and without going over it himself he doesn't care to submit it.

Mr. LYMAN.—I object, then to all the witness' testimony and ask that it be stricken from the record.

By Mr. RONEY.—Counsel for defendant directs the attention of the Court that the paper referred to is a statement of dates showing when certain streets were laid by Booth & Flinn, Ltd., and that the witness referred to no other portion of the paper which subsequently passed from Judge Head to Mr. McNeil. Counsel for Defendant objects to having the witness cross-examined on any portion of the paper, other than that which relates to the dates on which certain streets mentioned by him

(Deposition of Samuel D. Crago.)

were laid by Booth & Flinn, Ltd. Cross-examination upon these facts, relating to the dates of the laying of these streets, is not objected to by counsel for defendant. Cross-examination as to other portions of this paper is objected to as improper cross-examination, irrelevant, immaterial.

By Mr. LYMAN.—Do you, Mr. Roney, then decline to allow this witness to show me this memorandum he has used in testifying?

By Mr. RONEY.—No, I don't, I will let you see the memorandum he used. [905—361]

By Mr. LYMAN.—Mr. Roney detaches from the witness' papers used for refreshing his recollection, four sheets, headed "Vulcanite Streets, Pittsburgh, Pa." and retains in his own possession some dozen sheets, which constitutes part of the memorandum in the witness' hands when he testified. Further cross-examination is proceeded with after distinct notice is given that counsel for complainant will move to have this whole witness' deposition stricken out, on account of this, and without waiving any objections.

By Mr. RONEY.—Counsel for defendant admits that a portion of the paper retained by him was not used by the witness in refreshing his memory or for any other purpose during his present deposition, that the matter referred to by the witness during his deposition is now in the possession of counsel for complainant, and is merely a tabulated statement of dates, showing the time on which

(Deposition of Samuel D. Crago.)

certain streets mentioned by the witness were laid by Booth & Flinn, Ltd.

XQ. 11. Referring to these four sheets which Mr. Roney has been so kind as to allow me to see, I find that the statement is made as to Elgin Avenue, that it was laid from Hiland to Mellon Street in 1892 under specifications #4, the contractors being Booth & Flinn, Ltd. Is that correct?

A. That is taken from the records of Booth & Flinn., Ltd.

XQ. 12. I further find that as to Hiland Avenue, a notation on this memorandum is that it was laid from Bryant to Hiland Park in 1892 under specifications #4, by Booth & Flinn, Ltd. as contractors,—that is correct, is it not?

A. As taken from the records of Booth & Flinn, Ltd. [906—362]

XQ. 13. As to Lang Avenue, a notation on this memorandum is that it was laid from Penn Avenue, northwardly in 1893 under specifications #4, by Booth & Flinn, Ltd., contracts. That is correct, is it not? A. Yes.

XQ. 14. As to Bellefield Avenue, the memorandum says that it was laid from Forbes to Center Avenues in 1896, under specifications #6 by Booth & Flinn, Ltd., contractors, that is correct is it not?

A. Yes.

XQ. 15. I find no reference to St. Marie or Bond St., can you point out any?

A. (Witness indicating.) Yes.

XQ. 16. The notation you have now pointed out

(Deposition of Samuel D. Crago.)

on this memorandum says that Bond St. was laid from Hiland to Wightman in 1807 under specifications #6, by Booth & Flinn, Ltd., contractors, that is correct, is it not?

A. The memorandum states that the street was laid in 1807 and the year given should be 1897.

XQ. 17. What about the specification?

A. Under specifications #6.

By Mr. LYMAN.—I ask that these four sheets taken from the memorandum referred to by the witness be marked for identification and forwarded to the Court with this witness' deposition, the same being marked by the Examiner for identification, "four sheets from memorandum referred to by witness Samuel D. Crago."

By Mr. RONEY.—Counsel for defendant calls attention of the Court to the fact that the record is private property of the [907—363] witness. It is in many instances incorrect as to dates, and consequently is immaterial in this proceeding. It particularly incorrect with reference to the date of St. Marie or Bond St. which is given as being laid in 1807 instead of 1897. It is true that this can be cured by the witness and has been cured by him, but it shows inaccuracy on the part of the compiler, which must be explained by the witness.

XQ. 18. This memorandum refers to the specifications on which these pavements were laid, designating them as #2,#4 and #6,—and the other part of your memorandum which Mr. Roney has declined

(Deposition of Samuel D. Crago.)

to let me see, gave copies or abstracts of those specifications, did it not?

By Mr. RONEY.—Objected to as improper cross-examination.

A. There is some memorandum there regarding specifications.

XQ. 19. Those other sheets gave abstracts of those specifications? A. Yes, sir.

By Mr. LYMAN.—Do you still decline to let me see those sheets, Mr. Roney?

By Mr. RONEY.—I don't know that you are entitled to it at all.

By Mr. LYMAN.—In other words, you decline to let me see it.

By Mr. RONEY.—Yes, I decline on the grounds that you are not entitled to it, that the witness did not refer to the retained portion during his deposition. He merely referred to the memorandum for fixed dates.

By Mr. LYMAN.—Same notice as before, that the counsel for complainant will ask to have the whole deposition of the witness stricken out. [908—364]

Three inches was the thickness of wearing surface called for in the specifications. He accounts for the St. Marie St., Lang Avenue and Bellefield Avenue samples having different thicknesses by the fact that more of the foundation of the street is attached to the different samples. The wearing surface of those three pavements was practically the same when it was put down. There has likely

(Deposition of Samuel D. Crago.)

been more wear in one of those samples than the other. The two samples from Lang Avenue and Bellefield Avenue shows the most wear. St. Marie St. is more nearly in the condition in which the pavement was originally laid; the wear is somewhat more on Lang Avenue than St. Marie St. Taking St. Marie St.,—the wearing surface of the sample is close to what it was originally laid. Witness will say that the sample taken from St. Marie St. shows no perceptible wear. Witness is handed the sample of St. Marie St. and states the wearing surface of it is very close to three inches. Part of the binder course is attached to the wearing surface.

XQ. 32. The binder course is made up of these large particles which are cemented together with a shiny bituminous material, as on this sample?

A. That is hard to answer because of the fact that it is very well bonded together.

XQ. 33. I am asking you to tell me if I can tell the binder course by the fact that it is comparatively large pieces of stones coated with shiny bituminous material?

A. I would say that on the larger sample that the larger stones on the bottom of the sample are part of the foundation. [909—365]

XQ. 34. Then, between the foundation and wearing surface, is the binder course?

A. Well, we are not going into the specifications.

XQ. 35. I am asking you now, with reference to this particular sample?

(Deposition of Samuel D. Crago.)

A. It is part of the foundation.

XQ. 36. Intermediate between the foundation and the wearing surface is the binder course?

A. Yes.

In making his analysis of the St. Marie sample, he took the wearing surface, which includes from the surface of the pavement 2½ inches and not over 3 inches. They made these analyses in 1915 and attempted to arrive at what it really was. Referring to the Bellefield Avenue sample, the wearing surface is about 2½ inches on one side, and the other part is broken away, leaving it only about one inch. The witness indicates where it is 2½ inches, also the part on the sample that is widest, also the part of the sample that is three inches. The wearing surface is 2½ inches the whole on one side. On the other side, part of the wearing surface is broken off in taking out the sample. Witness doesn't know whether Bellefield Avenue pavement as originally laid, before the wear took place, was like this sample from St. Marie St. as it is now. The fact that the Bellefield Ave. sample has been worn down considerably more by traffic than the St. Marie St. sample would possibly explain some of the difference. Referring to the sample from Lang Avenue, part of the wearing surface is broken away on that. The wearing surface on one side is 2 inches and on the other it is broken away to nothing. It is a sample of the Lang Avenue pavement as it was in 1915. The whole of sample marked "Lang Avenue L, Crago May 8th, 1922"

(Deposition of Samuel D. Crago.)

is a portion of the wearing surface of Lang Avenue —as it appeared in [910—366] 1915. The sample exhibited is not the sample from which they made the test. The sample exhibited is a fair portion of the parts from which the analysis was made. They are fairly duplicates. His analysis of the sample included the same material in this sample exhibited from top to bottom, outside of the foundation attached. In making a test in order to get the composition of the wearing surface of the sample exhibited he would use practically all of it.

XQ. 63. Don't you know that the specifications under which these pavements were laid called for two separate layers, first the binder course and on top the wearing surface?

A. I don't care to go into specifications.

By Mr. LYMAN.—Same objection and notice as before.

Witness testified that Mr. Beck was the superintendent of the asphalt plant and witness saw them laid. Most of the Vulcanite streets were laid in two layers, with the top layer or wearing surface composed of smaller particles than the lower layer above the foundation. The streets are not always laid according to specifications. Witness took the samples from St. Marie St. and Lang Avenue and the one taken from Bellefield Avenue was taken by Mr. Beck.

By Mr. LYMAN.—Answer is objected to as hearsay, as far as the Bellefield Avenue sample is concerned, and that sample and all other evidence

(Deposition of Samuel D. Crago.)

relating to Bellefield Avenue is objected to as hearsay.

Witness personally took the sample from St. Marie Street which is in evidence. Referring to his affidavit which was offered in evidence wherein on page 3 it was stated that a portion of the pavement taken from St. Marie Street, formerly Bond Street, was delivered to William L. Beck Mr. Crago said he did not take it up himself; they took a laborer with them to take it up and take it over to the plant. He was present when Mr. Beck took up that sample. [911—367]

X. In your affidavit you did not say who it was taken up by?

A. Yes, he had charge of the asphalt plant and that didn't question Mr. Beck substituted my sample, as I identified it with my own mark.

XQ. 74. In that affidavit, you made no reference to any sample taken from Lang Avenue.

A. I think so.

XQ. 75. Look at your affidavit, and show me where you refer to taking a sample of Lang Avenue? A. (Witness indicating.) Here it is.

XQ. 76. I am asking you where you are reading?

A. Third page.

XQ. 77. Does that refer to any sample taken by you? A. Regarding Lang Avenue?

XQ. 78. I didn't ask you for anything but an answer to my question, which is, whether that affidavit refers to any sample taken by you or anyone else from Lang Avenue?

(Deposition of Samuel D. Crago.)

A. I don't see any reference here to the sample taken from Lang Avenue, which was taken by Mr. Betz of the Pittsburg Testing Laboratory and myself. I was present when it was taken.

XQ. 79. Did you make any reference to that sample in that affidavit anyway?

A. I don't see it here.

Referring to the four pages marked "Four sheets from memorandum referred to by witness Samuel D. Crago" the statement therein where it says that Dithridge Street from Fifth to Forbes was laid in 1894 under specification #6 by Booth & Flinn, Ltd., contractors, is correct. Has no personal knowledge as to whether this section of Dithridge Street was constructed in the same way as those other pavements. Has no knowledge of that street as it was laid before he was connected with Booth & Flinn, Ltd.

X. I am speaking about the streets you testified about. I am asking you if those streets were the so-called Vulcanite pavements?

A. As stated before, I don't care to discuss the specifications.

XQ. 84. You are unwilling to say that the heading on this memorandum which calls it Vulcanite is correct?

A. That is a copy of the record at Booth & Flinn's office. There are errors in it.

Witness' impression is that Bellefield Avenue, North Hiland Avenue, Lang Avenue and Elgin Street were all Vulcanite pavements. The sample

(Deposition of Samuel D. Crago.)

on Bellefield Avenue was taken not far from Forbes Street because they were tearing up the street in a northerly direction at that time. The sample from Lang Avenue which Mr. Crago produced was taken two [912—368] squares below north of Penn Avenue, near Meade Street. His recollection is that the exact distance is given on the sample. The sample that was taken from St. Marie Street was taken northwest of North Hiland Avenue. It is so stated on the sample. He is not sure unless he looks at the sample because he can identify the sample. His recollection is that it was taken west of North Hiland Avenue. His recollection is very clear on some of the others because he and Mr. Beck were there. He did not say he was sure as to Bond Street or St. Marie Street. He said it was his recollection.

XQ. 99. Now, you referred to some of these pavements as asphalt or bitulithic pavements, or at least, someone used that phrase?

A. Asphalt, I would call it.

XQ. 100. You didn't call it bitulithic?

A. I don't think I used that term. Mr. Roney used it.

He has made some tests to determine the percentages of mineral aggregate, bitumen. He had made tests of mineral aggregate before 1915, but had not dissolved concrete before that time. He was familiar at that time with making void tests. He did that by taking the mineral aggregate together from his samples, then he got vessels, and

(Deposition of Samuel D. Crago.)

filled up the voids using water in some cases; weighed the mineral aggregate and weighed the water to determine how much water it would take to fill the voids and arrive at that percentage of voids to fill them. He used water in making the tests in this case.

XQ. 111. These references in the four pages that have been called out and shown to me, referred to the specifications under which these pavements were laid by certain numbers, 2, 4, and 6. Those numbers relate to abstracts of the specifications which are included in and numbered correspondingly in that portion of your memorandum which has not been shown to me, does it not?

A. The proper answer to that would be the fact that this private memorandum you are referring to—I don't care to [913—369] discuss, because pavements are not always laid according to specifications.

XQ. 112. Then you decline to answer my questions?

A. The pavements are often laid better than the specifications.

XQ. 113. Then you refuse to answer my questions?

A. I testified that this is private memorandum taken from Booth & Flinn's records in their office, and is for my record only.

XQ. 114. In other words you refuse to answer my question? You haven't answered it. That is

(Deposition of Samuel D. Crago.)

as far as you are going then, and you won't say anything more in reference to it?

A. I don't think I will.

XQ. 115. That means you refuse to say anything more?

A. There is no reason for refusal, other than to say I don't care to go into discussion of several different specifications from 1915, since I was connected with Booth & Flinn, Ltd.

XQ. 116. The copies of these specifications under which these streets are laid are in your hands in connection with this memorandum, are they not?

A. I can't say that the pavements were laid according to the specifications.

XQ. 117. The copies of the specifications which are part of the contracts under which these pavements were laid are included in this memorandum, are they not?

A. The pavements were in all cases, I would say, laid better than the specifications.

Mr. LYMAN.—Answer objected to as volunteered, and not responsive to the question. I call the attention of the Court to the refusal of the witness to make answer to this question, and repeat the notice heretofore given. [914—370]

Redirect Examination.

(By JOHN H. RONEY.)

Mr. Crago's opinion and observation is that the various streets to which he has testified were laid much better than the specifications under which the contract was let. The wearing surface in many

(Deposition of Samuel D. Crago.)

cases contained more asphalt and large-sized mineral aggregate. The mineral aggregate was larger than the specifications called for. The wearing surface of the streets mentioned would indicate that there was mineral aggregate in there running up to ¼ inch. As a matter of fact, even the Ligonier screens used by Booth & Flinn, screens used in a quarry, would produce mineral aggregate exactly as the specifications called for. He knows this from personal knowledge, having had charge of quarries for some time. The mineral aggregate in the wearing surface in the various streets to which he has testified range from ¾ inches down to smaller size. In order to give a definite answer as to the mineral aggregate and as to whether or not the same was graded and as to the quantity of asphalt used, he would have to refer to some of his old notebooks on the analysis made in 1915, which he didn't bring with him. The mineral aggregate range in size from ¾ inches down to the finest of dust and sand. As to the exact method of mixing the material for the wearing surface, witness refers counsel to Mr. Beck who was superintendent of the asphalt plant.

Mr. LYMAN (At the Trial).—Now, I shall insist again on my objection, or my motion, it having been brought out on our own rebuttal testimony just what that memorandum was, that it was not private memorandum at all, but it was a copy which he obtained from the witness McNeil, which Mr. McNeil had and [915—371] which we obtained

(Deposition of Samuel D. Crago.)

from Mr. McNeil and put in evidence, and shows the specifications on those streets which were laid.

The COURT.—The specifications are in evidence?

Mr. LYMAN.—They are all in evidence.

The COURT.—I think his deposition should be taken with a good deal of allowance. He seems to be disposed to evade rather than to answer a question.

Mr. LYMAN.—The depositions, however, are, at least in evidence.

Counsel for defendant reads the testimony of WILLIAM L. BECK, taken on deposition before Clarence A. Williams, at Pittsburg, Pa., on May 1, 1922, as follows:

Deposition of William L. Beck, for Defendant.

Direct Examination.

(By JOHN H. RONEY, Pittsburgh.)

Witness stated his name was William L. Beck, residence 6834 Kelly Street, age 56, occupation superintendent asphalt works of Booth & Flinn. Has been employed by Booth & Flinn over thirty years. Witness is a chemist. Is familiar with the character of pavement laid on Bellefield Avenue. He removed a specimen of that roadway, about 1916, for analysis. He analyzed a portion of the piece removed. He personally analyzed it. Mr. Crago started with him in the analysis. He saw the samples removed, got to a certain place, and he started on the work, and about the time he started

(Deposition of William L. Beck.)

he met with an accident and was taken to a hospital. Can't remember positively whether Mr. Crago's accident happened during the analysis of Bellefield or Lang Avenue. Either one of the two. Counsel directs witness' attention to specimen marked "Bellefield Ave. B, 1896," and witness stated he personally supervised the [916—372] removal of the piece; was present during the entire time of its removal. There were several others present, Mr. William Reddy, Mr. H. R. Casky. They took the piece removed and brought it down to their place, locked it in the safe. They broke a portion of it off and made an analysis of it. Witness made the analysis.

Q. 17. Assisted as you said before, by Mr. Crago.

A. I tried to think, without getting my notes, to look back if he was on that or not.

The Bellefield Avenue pavement was put down by Booth & Flinn about 1895 or 1896, or in the early nineties. Witness is handed a paper and he states this shows an analysis, in his handwriting. The paper submitted to the witness is Defendant's Exhibit Analysis of Bellefield Avenue, Specimen B. The character of the wearing surface of the specimen he analyzed of Bellefield Avenue was about fifty-fifty. Stone running from 1½ inches down to ¼ inch, 2% dust and the other half sand, about 8% bitumen, and the voids 20.2%.

Q. 22. How did you determine the voids, Mr. Beck?

A. The way we went to testing out—we took cer-

(Deposition of William L. Beck.)

tain—say we have 16 oz. water and the other half, 16 oz. mineral aggregate, representing stone 1½ inches down to dust and sand, I haven't got the receipt we had, here, but it had some sulphur added and some cement to it in order to increase this 200 mesh to reduce the number of voids. The mixture was run about 405# stone, representing from 1½ inches down, as it came from their quarries and the crusher, and 1½ inches down to the finest stuff you find, and bitumen, was added, and asphalt and #4 pitch, and #4 pitch, we had a string of our own tank cars. Take 16 oz. water [917—373] and dump the stone in the water, and the difference between the two is the measurement of the voids.

There were other people making tests in other ways, too, but that is the way they decided the best. That gave a reasonably accurate statement of the voids contained in the construction. There were various kinds of pavements being made, and they had a pavement they considered superior quality than what the specifications called for.

By Mr. LYMAN.—It is understood, Mr. Roney, that the objection made this morning in connection with the witness Samuel D. Crago applies to all testimony relating to these Pittsburgh pavements on the grounds that there is no basis in the answer for the introduction of such evidence.

Their own pavement differed from the other pavements he has referred to in the mix of the stone, cement and sand, and of the mineral aggregate together in one mix. In the wearing surface.

(Deposition of William L. Beck.)

They had a pavement that had a finer aggregate and when you put it on thick enough, like 1½ inches, it would creep off the hills and creep down the gutters, and slide down the road, and we would have to put our mineral aggregate, stone and sand in one mix to make it stay home. He is speaking from experience. The wearing surface of Bellefield Avenue roadway was composed of sand, stone, asphalt. The range of graduation in the stone was about fifty-fifty. The size of the mineral aggregate was whatever went through their screens, from 1½ inches down to ¼ inch. There were many other roadways of the character of Bellefield Avenue laid by Booth & Flinn prior to 1895. North Hiland Avenue was one of the roadways; laid in the [918—374] early nineties. They got samples of North Hiland Avenue in 1916, and the wearing surface was fine. He analyzed the wearing surface of North Hiland Avenue but hasn't the analysis with him. Counsel hands witness a paper which witness states purports to be analysis of a sample of North Hiland Avenue at #1317, 49 feet from a fire plug. Witness' attention is directed to a large specimen in a box and he says that is a sample from North Hiland Avenue. This analysis relates to that specimen. Mr. Beck took up the sample from North Hiland Avenue and he and Mr. Reddy delivered it to the Pittsburgh Testing Laboratory. There are marks of identification on the sample. The sample since it has been taken up has been in the plant in his care in a safe until

(Deposition of William L. Beck.)

it landed in this case. He has had it there since April 12, 1916. It was signed by the man who made that analysis of this same sample. The largest sized aggregate present in his test shows in the Pittsburgh Testing Laboratory test. The only thing that is missing on their test is the seal coat. There was a reason for putting this larger stuff down because the stuff rolled up like a blanket and left the streets flat and rolled down the hill and Booth & Flinn had to put their own pavement down, which is a superior kind of pavement, and rake it over. The city specifications according to the pavement, and they came out right along, until the sheet asphalt kept getting finer and finer. In the early times it was heavy and coarse and large stuff. The city specifications ran from one inch and half inch down to dust. Booth & Flinn wanted a larger sized stone on some of the early streets. Then the city changed their specifications and kept getting material finer and finer right along and in some of the samples you will find there [919—375] is nothing but ½ inch stone used in the surface but you could not put the stone on the top of the pavement and call it the wearing surface because it would not wear. The Bellefield Avenue and North Hiland Avenue pavements were not laid in conformity with the specifications. Booth & Flinn had a larger stone and sealed it over with finer stone. The mineral aggregate of the wearing surface was larger and was graded down larger than the mineral aggregate of the city specifications. Booth &

(Deposition of William L. Beck.)

Flinn always had difficulty in their practice in laying under the city specifications for as late as 1915 the streets rolled up like blankets. To remedy this they got coarser stuff and rolled it in. Later on they could not stop Booth & Flinn, they heated it up and surfaced it over. Beck was present when the Bellefield Avenue exhibit was taken out of the roadway; and when the specimen "St. Marie St." was taken out; and when the specimen marked "Lang Avenue" was taken out; and was present in supervising the taking out of the piece of North Hiland Avenue.

Specimens of North Hiland Avenue referred to by the witness was offered in evidence and marked "Defendant's Exhibit North Hiland Avenue."

Mr. LYMAN.—Objected to on same grounds previously noted, namely that there is no basis laid in the answer for any such evidence.

Mr. Beck identifies an exhibit marked "Defendant's Exhibit Analysis of the Sample of St. Marie St." which was misplaced and did not get in evidence. He is also handed [920—376] a paper which witness identified as analysis of Elgin Street, 150 feet north of North Hiland Avenue made by himself, which was offered in evidence as "Defendant's Exhibit Elgin Street Analysis." Beck made an affidavit in the case of Warren Bros. vs. City of Allegheny, Booth & Flinn, and others at No. 37 November Term, 1915, Western District of Pennsylvania, and which is an analysis of the sample taken from St. Marie Street, formerly Bond Street.

(Deposition of William L. Beck.)

Mr. Beck made that analysis personally. This analysis was offered in evidence as "Defendant's Exhibit Beck Affidavit." (Objected to by complainant.) His signature appears thereon.

Cross-examination.

(By Mr. LYMAN.)

Witness' reference in his deposition to Bellefield Avenue is to that portion of it near Forbes Street. His references to North Hiland Avenue relate to about 1300 North Hiland Avenue, from Grafton Street north to Highland Park. His testimony as to Lang Avenue refers to Lang Avenue below Penn Avenue. If Penn Avenue runs west it would be north a couple of blocks, to some boulevard. He thinks it Thomas Boulevard. In referring to Bond or St. Marie Avenue he refers to that part of it east of Hiland Avenue, about one square. Bond Streets runs only one way. These streets were not known as Vulcanite when they were laid in the early days. No name at all. They were asphalt pavements. All laid by Booth & Flinn. Witness saw all four of them laid, which was under his supervision. He knows all of them, what they put in them and saw them put down there. Saw every street being laid. They were laid under a contract with the City of Pittsburgh. They were not laid according to the specifications. Witness has no personal knowledge of the [921—377] contract, never saw it. Bellefield Avenue is in existence today he believes. He is not positive. Others have been covered up since 1916. He thinks the dummy

(Deposition of William L. Beck.)

is left of Hiland Avenue, that is between the two car tracks there is still a piece left, a section. He is not positive whether Bellefield is still in existence. North Hiland except between the car tracks is covered up. He believes Lang Avenue is covered up. He believes St. Marie Street is still there yet. Don't know if it is covered up. Mr. Beck didn't see any specifications but the street was laid down and before the contract was finished it started to creep and they had to make changes to a different character of pavement. He knows there was a written contract. Though he didn't know the specifications he thinks they departed from them.

XQ. 107. You say that the pavements were laid under the specifications of the City for Vulcanite pavements and were no good?

A. When you are getting into Vulcanite you are getting into different character of pavements.

XQ. 108. Records produced this morning by Mr. Samuel D. Crago show that these streets were covered by Vulcanite pavements. Do you venture to deny that these records are right?

A. They are not right.

By Vulcanite pavements he means where it is laid in two courses, with a binder on the bottom and a finer aggregate on top. A binder course is made of stones of itself and the top course is made of stone and sand. The stone runs anywhere from 1½ inches down to dust. Some Vulcanite pavements are different. If they could get the [922—378] finer aggregate they did. They tried to get

(Deposition of William E. Beck.)

it as fine as they could. Don't remember how thick they laid the pavement. Don't know whether it was two inches on top of an inch of binder or one inch on top of what they call a two inch binder. Some of them are finer and some of them bigger, or whether it was an inch stone and continuous mixture. Booth & Flinn had continuous mixtures all the time.

XQ. 115. Isn't it a fact that in the Vulcanite pavement the binder course is made of large stones, say 1½ inches and on top of it was laid a wearing surface which was also 1½ inches thick, and the wearing surface was made of very small particles?

A. Not always.

XQ. 116. Supposed to be, wasn't it?

A. Not always.

All witness has with reference to specifications is a receipt showing the aggregate of the whole thing from Senator Flinn, who telegraphed him, and witness had to go according to that and never saw the specifications. The receipt from Senator Flinn is as follows:

100 # pitch,
45 # asphalt,
145 # wearing surface,
135 # composition,
405 # stone,
405 # sand,
½ gallon cement,
½ pint sulphur,
1 pint lime,

(Deposition of William L. Beck.)

Sand to be heated 250 degrees when it exceeds 260 degrees to be thrown out. Composition not to exceed 260# and not to be less than 220 degrees. [923—379]

The pavements were laid with a binder course of stone from 1½ inches down and a wearing surface laid on top of that. The material finer than the ¼ inch crept and was satisfactory. To remedy the trouble they took the pavements up and put them down again. Booth & Flinn put down their mix, a mixture of stone, sand and asphalt all mixed together. The other had a finer aggregate and run from ½ inch down, anything that went through an ⅛ inch screen. When it started to creep down hill they started to put a seal coat on it and sealed it up. As originally laid a portion of Bellefield Avenue had that mix. Witness does not know the mixture on the rest of Bellefield Avenue. For a binder course they used #4 pitch, poured it all over the top of the ballast, base and binder together combined. On the top of this base and binder was placed the wearing surface which was 1½ inches to 2 inches thick and composed of sand, stone and asphalt, of which some of the stone was 1½ inches big. Whatever was sent Beck had to use. As near as the crusher would grade the thing they got the big stuff and put on the stone, and then this next size came in. The lower portion of Bellefield Avenue about 1,000 yards may have been laid that way. Bond Street had a crown on it and crept down one side. Does not know if Bond

(Deposition of William L. Beck.)

Street was laid the same as Bellefield Avenue or different. Does not remember about Lang Avenue. Hiland Avenue had been taken up on account of the steepness of the grade; the specifications would not stay there. Park Avenue, Paulson Boulevard, and a lot of them were laid with this mix. [924—380]

XQ. 140. Of these four you produce samples, the only one laid originally was Bellefield Street of your mix?

A. I could not tie myself down to that.

Only a portion of Bellefield Avenue was laid with this mix, a thousand yards at least. Samples were taken 20 feet or so from the curb. He thinks about 50 feet from Forbes Street and 20 feet from the curb. The other reports may show differently. The wearing surface of this portion of Bellefield Avenue that had this mix was about 3 inches thick. The seal coat that was put over it was ½ to ¼ inch thick. In some places it was just a mere veneer. In some places where the roll went over it the stones showed through. The reason they wanted to keep the stones from showing was to have a smooth looking pavement. Sheet asphalt came out about 1900. Up to that time the tendency of the city specifications was drifting finer to smaller and smaller particles. Don't know whether Booth & Flinn ever took out a license under the Warren patent.

XQ. 152. Which of these four streets you refer to have you actually seen laid?

A. I saw the lower part of Bellefield Avenue laid.

(Deposition of William L. Beck.)

I only drop around there a couple times a day, and saw it laid right along.

XQ. 153. Is it your testimony that the Bellefield Avenue pavement was not laid in layers for this 1,000 yards? A. No.

Does not know how the rest of Bellefield was laid. Where this 1,000 yards of this mix was laid Bellefield Avenue had a grade all the way up, a fall to it. It had more than a 1% grade. There is a steeper grade going up Center Avenue.

XQ. 159. Mr. Beck, please tell me from exactly what part of Bellefield Avenue you took this sample you produced in evidence.

A. Well, say 50 feet from Forbes, 20 feet from the curb.

XQ. 160. Which direction from Forbes Street? A. North. [925—381]

XQ. 161. This analysis says that the sample was taken 10 feet from the west curb, 20 feet north of Forbes Street—is that correct? A. Yes.

That part of Bellefield Avenue from which the sample was taken was paved with his mix. Doesn't recollect which part of Bellefield Avenue was paved first. The grade of this avenue increases as it goes north so that the portion of which the 1,000 yards was on is flatter. This 1,000 yards had a greater pitch than St. Marie Street.

Redirect Examination.

(By Mr. RONEY.)

In the memorandum that William Flinn sent him December 12, 1891, the 405# stone was from 1½

(Deposition of William L. Beck.)
inches down and it went into the wearing surface. North Hiland was put down by Booth & Flinn not earlier than 1892 and not later than 1896. The 1,000 yards on Bellefield Avenue was laid about 1896. This North Hiland Avenue was laid the same way as the 1,000 yards of Bellefield Avenue mentioned.

Adjournment.

May 29, 1922—Resumed.

Counsel for defendant reads the testimony of WILLIAM M. REDDY, taken on deposition before Clarence A. Williams, at Pittsburg, Pa., May 1, 1922, as follows:

Deposition of William M. Reddy, for Defendant.

Direct Examination.

(By JOHN H. RONEY, Pittsburgh.)

His name is William M. Reddy, resides #611 Euclid Avenue, Pittsburgh, occupation pipe fitting, stationary engineer and other work. Did work for Booth & Flinn, Ltd. Thinks he was present when portion of North Hiland Avenue [926—382] was removed. Was working at the plant at that time. Does not know what they were removed for. He cut a piece out from North Hiland and St. Marie Streets and wheeled it down to the asphalt plant in 1915, also a piece of Bryant Street. He marked a piece out on North Euclid Avenue and sent a man over to cut it out. He did not remove a piece from Bellefield Avenue. The sample marked "North Hiland Avenue" he knows as well as if he were

(Deposition of William M. Reddy.)

taking it out now. Mr. Beck, superintendent for Booth & Flinn, requested him to take this piece out from North Hiland Avenue, and he brought it to Mr. Beck's office. His signature is on it, signed on the blue paper.

Cross-examination.

He took samples from other streets. Marked out one on North Euclid Avenue for a man to take out.

XQ. 23. Who told you where to get your samples?

A. Well, I went and looked myself and picked it out.

The reason he took them from the particular places he did was because it was not a dangerous place for traffic. He took it out as much as possible so not to injure anything. The North Hiland specimen he took out close to a fire plug near Senator Flinn's house.

Counsel for defendant read the testimony of H. R. CASKEY, taken on deposition before Clarence A. Williams, at Pittsburg, Pa., May 1, 1922, as follows:

Deposition of H. R. Caskey, for Defendant.

Direct Examination.

(By JOHN H. RONEY, Pittsburgh.)

Witness' name is H. R. Caskey, age 48, residence #510 Cora Street, occupation assistant superintendent for Booth & Flinn, Ltd. Has been employed by them 27 years. Was [927—383] pres-

(Deposition of H. R. Caskey.)

ent when a portion of Bellefield Avenue was removed. Was directed to remove it by John H. Roney. Mr. Beck was present and he thinks Mr. Reddy was with them. He thinks specimen marked "Exhibit Bellefield Avenue" is the one. It was taken near Forbes Street probably 50 feet north. He was present during the removal of a portion of North Hiland Avenue. Does not remember the date but Mr. Beck and he took it from North Hiland Avenue. He does not know the exact location, probably up the next block. Not up as far as the residence of Senator Flinn. Identifies the specimen marked "North Hiland Exhibit" as the one that was removed. Does not remember of Mr. Reddy was with him in the removal of that piece. When removed it was taken to the asphalt plant. Another sample was taken out on St. Marie Street. Identifies the "St. Marie Sample" exhibit as the one. Does not remember the date it was removed, possibly something like nine years ago. The reason it was removed was that they wanted to show that they could get a pavement similar to Warrenite at that time. Warren Brothers tried to get an injunction against Booth & Flinn, Ltd.

Cross-examination.

(By Mr. LYMAN.)

When they took the samples from the surface of the street Bellefield Avenue had been patched in some places. The places that had been worn out or cut.

(Deposition of H. R. Caskey.)

XQ. 22. Is it your recollection that there was any 1,000 yards of Bellefield Avenue looked different from the rest of the street?

A. Well, there may have been some had a little more seal coat on it. [928—384]

Sample mentioned was taken from a place where there was no seal coat; where the seal coat had been worn off. The only place, he thinks, where it would not be worn off would be toward the gutters. North Hiland looked on the surface like Bellefield Avenue, according to his recollection. North Hiland Avenue presented a uniform surface and appearance. He was not with Booth & Flinn, Ltd., when the pavements were laid. He was not in that department. He thinks the last he laid was up to 1897. Pavements were laid under a contract with the city. Contracts had certain specifications to which the pavements were to conform.

XQ. 30. Is it your practice to lay pavements according to specifications?

A. Not at that time.

He was not assistant superintendent at that time. Has no knowledge of the practice at that time. Since he has been connected with the company it has been the practice to lay pavements as near as they could in conformity with the specifications. There were times when they didn't have a certain material they used the next best. He will not say that they came close to the specifications. He is familiar with the signature of William Flinn. The signature on the document marked "Flinn receipt,

(Deposition of H. R. Caskey.)

1891," by Mr. Beck looks like Mr. Flinn's signature. The signature on another document, contract between Booth & Flinn, Ltd., and the city of Pittsburgh for the improvement of North Hiland Avenue looks the same as his signature. The signature on another contract between the city of Pittsburgh and Booth & Flinn, Ltd., for the improvement of Dithridge Street from Fifth Avenue to Forbes [929—385] Street looks the same. Does not think he would know the signature of H. A. Booth. Has been so long since he saw it. The signature on another document, contract between Booth & Flinn, and the city of Pittsburg, for the paving of St. Marie Street, formerly Bond Street, from North Hiland Avenue to Whiteman's Line, is that of Mr. Flinn. William Flinn is President of Booth & Flinn, Ltd. He was president from 1895 on. He understood he was an officer of the company before that.

Contracts referred to were, at Mr. Lyman's request, marked for identification as follows:

Booth & Flinn contract for North Hiland Avenue from Bryant Street northwardly.

Booth & Flinn contract from Dithridge Street to Forbes Street.

Booth & Flinn contract for Bond Street from Hiland Avenue to R. Whiteman's line.

"The COURT.—Was the suit brought by Warren Brothers against the city of Pittsburg tried out?

"Mr. LYMAN.—There were two suits there, as

(Deposition of H. R. Caskey.)

I understand, first against the County of Allegheny, and that was settled by a consent decree for the plaintiff, as I remember it, and then there was a later suit against Booth & Flinn and the city of Pittsburg before the same court, and there were affidavits presented on motion for preliminary injunction and came before Judge Orr, and Judge Orr denied the preliminary injunction. The case didn't come to final hearing, but, as appears from subsequent depositions here, Booth & Flinn determined it by taking a license under this patent.

"Mr. LILJEQVIST.—We don't know anything about that—

"Mr. LYMAN—(Interrupting.) Well, it is in the deposition [930—386] as taken at Pittsburg as testified by the witness McNeill.

"The COURT.—Well, you referred the other day to a decision by Judge Park.

"Mr. LYMAN.—No, that was a case in Ohio.

"The COURT.—Oh, that was an Ohio case.

"Mr. LYMAN.—That was a reported case and we have the printed record in that case. There are two contracts here, one, the first one, was the North Highland Avenue from Bryant Street northwardly.

"The COURT.—When was it executed?

"Mr. LYMAN.—That was executed in 1893. It is between the City of Pittsburg and Booth & Flinn, Limited, for the paving of North Highland Avenue from Bryant Street northward, and these specifications are annexed to that. Here are the pertinent

(Deposition of H. R. Caskey.)

parts, under the heading, 'Preparation of roadbed for Asphalt Pavement.' After speaking of the removal of paving and other stones and so on it goes on:

"'Upon the foundation thus prepared shall be laid a bed of broken stone six inches in depth when rolled, said stone to be broken that none shall measure more than three inches in any direction, nor less than two inches, the stone to be Ligonier granite, spalls, or of hard native stone. This layer shall be compactly rolled, to the satisfaction of the Superintendent of Engineering and Surveys with a steam roller of not less than ten tons weight.'

"Upon this roadbed when rolled there shall be 'poured a hot composition distilled expressly for the purpose, using not less than one gallon to the square yard so as to thoroughly permeate all crevices, or spaces, thereby [931—386 (a)] making the latter one solid mass, and a binder consisting of clean broken Ligonier granite stone not to exceed one and one-half inches in diameter well heated through revolving heaters and properly mixed with hot composition through steam mixture, shall then while hot be spread evenly in such quantity as to be one and one-half inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition, well heated and thoroughly mixed through steam mixers, shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or

(Deposition of H. R. Caskey.)

pavement proper. The binding material which is a cement prepared with refined Trinidad asphaltum and heavy petroleum oil, unmixed with any of the products of coal tar. The asphaltic cement shall be prepared in the following proportions:'

"The COURT.—Laid in two layers or three?

"Mr. LYMAN.—No, two; I will get to the wearing surface in a minute. 'Upon this surface will be laid a wearing surface or pavement proper. The binding material which is a cement prepared with refined Trinidad asphaltum and composition of pitch (expressly distilled for the purpose) commercially known as No. 4. The asphaltic vulcanized cement shall be prepared in the following proportions:

" ' Asphalt, from 28 to 43 parts;

" 'No. 4 pitch from 52 to 57 parts.

" 'The wearing surface shall be composed of:

" 'Asphaltic cement from 14 to 18 parts;

" 'Crushed Ligonier stone from 43 to 41 parts;

" 'Sharp river sand from 53 to 41 parts;

[932—386 (b)] " 'with sufficient sulphur, lime and cement to harden the asphaltic cement. The whole to be screened through a revolving screen with openings of one-fourth an inch, and heated in revolving heaters and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder in such quantity as, when compactly rolled with steam roller, to be one and one-half inches in thickness, the whole making one homogeneous mass.'

(Deposition of H. R. Caskey.)

"The COURT.—How do you understand from that that the street was to be laid?

"Mr. LYMAN.—The street was to have been laid in three courses, the first was three inch stone of uniform size, then a binder course of what they call one and a half inch stone with gravel or sand to make it smooth, and then the layer on top of that to be made of a composition of sand, crushed stone and cement, every part of which had to come through a screen with a one-quarter inch mesh so that no particles occurred in that pavement—

"The COURT.—(Interrupting.) That wearing surface was to be how thick?

"Mr. LYMAN.—Has to be one and a half inches thick, and this expressly required that that wearing surface shall have no particles larger than a quarter inch. Now, the Dithridge Street contract, that was another of the streets mentioned in the specifications and that they gave us notice of, that is the reason it was put in here. It is just the same, it is identical with that. Now, I will ask that the contract be offered in evidence. I offer the contract in evidence, the contract for the pavement of North Highland Avenue from Bryant Street northwardly, as Plaintiff's [933—386 (c)] Exhibit No. 31, and the contract for the pavement of Dithridge Street as Plaintiff's Exhibit No. 32.

"Mr. LILJEQVIST.—For the purpose of the record I object for the reason that the evidence shows that the specifications were not followed but were altered.

(Deposition of H. R. Caskey.)

"The COURT.—It is the type of construction.

"Mr. MONTAGUE.—And what was the street Exhibit 31, Mr. Lyman?

"Mr. LYMAN.—The first one was North Highland Avenue and the second was Ditheridge Street.

"(Thereupon, Mr. Lyman read the deposition of Carter Johnson, a witness produced on behalf of defendant.)

"Mr. LYMAN.—You might as well read the deposition taken by plaintiff immediately following at this time too.

"Mr. LILJEQVIST.—It is understood that that is part of the plaintiff's case then?

"Mr. LYMAN.—Yes, but while the subject matter is up I should think it would be wise to put it in here.

"Mr. LILJEQVIST.—That is all right.

"(Thereupon Mr. Lyman read the deposition of Donald McNeill, a witness called on behalf of plaintiff. During the reading of the latter deposition the following colloquy occurred between the Court and Mr. Lyman:)

"Mr. LYMAN.—He testified at first that this came from Bond Street instead of from Bellefield Street, and then you will see in a moment that he corrected his testimony; he went by the tag, which got on by mistake, and then he identified it. These two specimens were taken from the same street. [934—386 (d)]

"The COURT.—About the same locality?

(Deposition of H. R. Caskey.)

"Mr. LYMAN.—I can't say definitely about that. It is my impression that they were taken as nearly as possible from the same locality, except I think the difference was this that this was taken from the middle of the street and this from the other side where there hadn't been so much traffic; I think that was it.

"(Mr. Lyman thereupon continued the reading of the deposition. During such reading the following occurred:)

"Mr. LYMAN.—There is another mistake by that very stenographer or in some way in marking these samples he got that mixed up, No. 1 is from Bellefield Street and No. 2 from St. Marie Street. These two tags should be changed.

"The COURT.—Now, this No. 1 is from what street?

"Mr. LYMAN.—No. 1 is from Bellefield; this is St. Marie and this is Bellefield, just reversed.

"(Mr. Lyman thereupon continued the reading of the deposition, and during such reading the following occurred:)

"Mr. LYMAN.—Now, here is that document filed by McNeill, a complete list of all the vulcanite streets. Those first pages are identical with the other mentioned by Crago, and here is 1, 2, 3, 4 specifications. I offer that document in evidence as Plaintiff's Exhibit No. 33.

"Mr. LILJEQVIST.—I understand there was an objection made at the time of the taking of the deposition.

(Deposition of H. R. Caskey.)

"Mr. LYMAN.—There is an objection, I offered several things in evidence and at the same time, and then there was—

"Mr. LILJEQVIST.—(Interrupting.) And that record goes as it [935—386 (e)] is made there; I think that is the law anyway as I understand it.

"Mr. LYMAN.—I will read the whole thing here and then the objection.

"(Thereupon, Mr. Lyman continued reading of the deposition.)

"The COURT.—That is the way they are marked, I assume, from your statement, plaintiff's exhibit.

"Mr. LYMAN.—I just offered two of them.

"The COURT.—But you referred to them as plaintiff's exhibit.

"Mr. LYMAN.—Yes, they are marked there or are marked by this examiner out there.

"Mr. MONTAGUE.—Well, you had better ask that they be differently marked for this record.

"Mr. LYMAN.—Two of them we have already offered.

"Mr. LILJEQVIST.—Just for the record, to clarify it, what proceeding was it you claim that subsequently Warren Brothers and Booth & Flinn got together and made out a license?

"Mr. LYMAN.—This same one.

"Mr. LILJEQVIST.—What is the name of that case, the City of Pittsburg case?

"Mr. LYMAN.—Well, there is an affidavit here

(Deposition of H. R. Caskey.)
that is annexed produced by this witness, that is the exact title of it, this previous affidavit—Warren Brothers *County* against County of Allegheny, I. M. Campbell, J. D. O'Neill and S. J. Toole, County Commissioners, and Booth & Flinn, Limited, November term, 1915.

"Mr. LILJEQVIST.—You said something about the Pittsburg case, I wanted to know—

"Mr. LYMAN.—I guess I was wrong in saying they were both Pittsburg. One was Allegheny County." [936—386 (f)]

Counsel for defendant read the testimony of CARTER JOHNSON taken on deposition before Clarence A. Williams, at Pittsburg, Pa., May 1, 1922, as follows:

Deposition of Carter Johnson, for Defendant.

Direct Examination.

(By JOHN R. RONEY, Pittsburg.)

Witness' name is Carter Johnson, age 57, residence 5637 Mignonette Street; worked for Booth & Flinn, Ltd., 36 years laying asphalt. Cut a portion out on North Hiland Avenue. Does not recall exact date. Mr. Beck and Mr. Reddy were present. Mr. Caskey came by there. Showed witness where to get them. When the piece was cut out it was sent to the asphalt works. Did not cut out sample from any other streets. He worked on North Hiland pavement in 1897. He [937—386 (g)] helped put down the pavement on this street, a portion of which was cut out. The pavement was what

(Deposition of Carter Johnson.)

they called Vulcanite. Broken stone foundation and over it was laid big stones. Witness put in the big stones when the pavement was laid, and then the ballast over it and rolled them in and then mixed this over brought from the yard.

Q. 15. What was the mix they brought from the yard? A. Asphalt.

Q. 16. What was in the mix?

A. Stone and then seal coat on top.

Q. 17. How big was the stone?

A. It run from 1¼ inch down.

Q. 18. In this particular job, North Hiland Avenue? A. Yes.

Q. 19. They put the seal coat on top did they?

A. Yes.

Q. 20. When was North Hiland Avenue put in?

A. I think about 1894. I don't remember.

Witness' attention is directed to a sample marked "Exhibit North Hiland Avenue" and stated that he cut that piece out. Mr. Reddy was present. The top surface, as shown on this sample, was brought from the asphalt works. He laid it and rolled it down. He did work on Bellefield Avenue. Larger stone was used on Hiland than on Bellefield. Sometimes they got a lot of stone too small. The first time he worked there Bellefield Avenue was laid from Center to Fifth and the second time from Fifth to Forbes. He was employed there when they laid the street from Fifth to Forbes. There was small stone in the wearing surface in that portion of Bellefield Avenue from Fifth to Forbes

(Deposition of Carter Johnson.)

and the same on top. He did not work on the second part. [938—387]

Cross-examination.

(By Mr. LYMAN.)

Mr. Beck told witness where to cut this sample from North Hiland. The street looked the same all over. Did not cut any other samples. He cut only one sample from North Hiland Avenue.

By Mr. LYMAN.—I notice that counsel for the defendant has not put in evidence a sample which is here, among the others, which says North Hiland Avenue at Grafton Avenue, 1893.

XQ. 23. Is that sample taken from about the same place as the sample you took? A. No.

XQ. 24. How far is that from the sample you took? A. Mine is up above Bryant Street.

XQ. 25. How far is that from Grafton Avenue?

A. About 400 to 500 feet.

XQ. 26. Hiland Avenue, North, runs from Bryant Street to Highland Park, does it?

A. It runs from Penn Avenue. Grafton Street crosses North Hiland Avenue. That street was not open and was not paved.

XQ. 27. What I am asking is whether Grafton Street is between Bryant Street and Highland Park?

A. They changed the name since. [939—387 (a)]

XQ. 28. Referring again to this sample which counsel for defendant did not offer in evidence and which is marked "North Highland Avenue at Grafton Avenue, 1893," you did not cut this sample?

(Deposition of Carter Johnson.)

A. No.

XQ. 29. Does that represent the kind of pavement you laid on North Hiland Avenue?

By Mr. RONEY.—Objected to as utterly incompetent and improper cross-examination, and the Court's attention is directed to the fact that this witness subsequently stated that he cut but one piece from North Hiland Avenue, and he also stated that he did not cut the sample in the possession of counsel for complainant. Counsel for defendant protests against this character of examination in view of the kind of witness being examined. Mr. Johnson is a man whose testimony indicates that he was employed merely to put down certain character of material. His testimony also indicates he was employed to take out a piece of roadway which he did, and that was the only purpose for which he was put on as witness, to testify as to the removal of a certain piece of roadway. No interrogatories directed to him concerning any other subject matter is manifestly incompetent and improper cross examination.

A. That is the piece I worked on. (Witness indicates the piece marked North Hiland Avenue, Exhibit in this case.)

By Mr. LYMAN.—I ask that the sample I have shown the witness, and which was taken from the samples in possession of defendant's counsel, and which is one of two not offered in [940—388] evidence by defendant's counsel, to be marked for identification, "Sample of North Hiland Avenue"

(Deposition of Carter Johnson.)

in possession of defendant's counsel not offered in evidence by defendant's counsel."

By Mr. RONEY.—There is no evidence that the sample alleged to be from North Hiland Avenue is from North Hiland Avenue, and the identification of this specimen as a portion of North Hiland Avenue is protested as wholly unwarranted.

By Mr. LYMAN.—I do not understand whether counsel for the defendant is refusing to have this exhibited at court or not. Will counsel for the defendant kindly make it plain?

By Mr. RONEY.—Counsel for the defendant submits he might as well permit the piece of the roadway to be sent to court as evidence of the construction of the roadway of Hiland Avenue, as the specimen is spoken of. It is manifest from the inscription on the specimen, that it is not the portion of the roadway North Hiland Avenue testified to by the witnesses examined. Subject to the objections, counsel for the defendant has no objection to the identification of the sample.

By Mr. LYMAN.—I ask, therefore, that it be sent to court with the other samples.

XQ. 30. You say that both the pavements on Bellefield Avenue and North Hiland Avenue were Vulcanite pavements?

A. Asphalt. The name just came up Vulcanite here lately.

XQ. 31. You say that particles of stone used in the wearing surface in the Bellefield Avenue pave-

(Deposition of Carter Johnson.)

ment were finer than those used in the North Hiland Avenue pavement? A. Yes. [941—389]

XQ. 32. Bellefield Avenue—was it laid in three layers, base, foundation, binder course and wearing surface? A. Yes.

RDQ. 33. (By Mr. RONEY.) Mr. Johnson, the wearing surface put on the Bellefield Avenue roadway, was that made at the asphalt works, mixed up and sent to you, and the stone in that ranged from what size to what size?

A. Yes, from 1 inch to 1¼ inch, down to nothing.

By Mr. LYMAN.—After the previous question had been put and answered by this witness, counsel for the defendant said, "That's all." I began to ask a question in cross-examination, which was substantially as follows: "You are now talking about the binder course on Bellefield Avenue, are you?" whereupon counsel for defendant intercepted and refused to allow the witness to answer this question, and had the preceding question read to the witness and pointed out that it indicated the wearing surface. Therefore, I will not ask the question which I had asked and leave the Court to judge as to its fairness.

By Mr. RONEY.—Counsel for defendant denies the allegations allowed by the counsel for complainant occurred at all. He was about to ask a manifestly misleading question, misleading when the last question by the counsel for defendant is considered. The question was intended to confuse the witness.

(Deposition of Carter Johnson.)

By Mr. LYMAN.—Under the circumstances I decline to cross-examine further. [942—390]

Mr. LILJEQVIST.—I wish to state that counsel for complainant has offered in evidence over objection of the defendant certain records of certain courts for the purpose of showing what was filed therein, what was presented to those courts, and for the purpose of explaining the decisions of the Court, and whatever effect they should have. Now, to meet that issue and also for the purpose of showing that other courts have held contrary to the decision that complainant relies on, I offer in evidence a certified copy of the bill of complaint referred to by counsel in the deposition just recently taken at Pittsburg in the United States District for the Western District of Pennsylvania entitled Warren Brothers Company versus County of Allegheny, et al., No. 37, and ask that it be marked Defendant's Exhibit. I am going to offer sufficient to show the record in the case what was the status.

(The document last above referred to by Mr. Liljeqvist was thereupon marked Defendant's Exhibit "Z.")

Mr. LYMAN.—Now, if you are going to put in the record in that case, I have no objection at all, but you ought to put in the whole record just as in these other cases, and I think you ought to put it in as one exhibit instead of in parts.

Mr. LILJEQVIST.—We couldn't go and get exhibits all over the United States, the cost would be prohibitive, and the time has been insufficient. I

(Deposition of Carter Johnson.)

am going to offer sufficient to show the record in the case what was the status.

Mr. LYMAN.—Well, go ahead in your own way and we will see.

Mr. LILJEQVIST.—We also offer the answer filed in that case by defendant.

Mr. MONTAGUE.—Now, just a minute. Are you offering these all as one exhibit?

Mr. LILJEQVIST.—I am offering them separately to make the record so the Court can understand what was decided in that case. I offer the certified copy of the docket entries in the case, which show that the application for preliminary injunction was refused and the payment of the costs of the case by the complainant. [943—391]

(The last two documents above referred to were thereupon marked Defendant's Exhibit "A–1" and "A–2.")

Mr. LILJEQVIST.—Now, Judge Clark refers in his decision to the fact that in a number of cases where Walter Logan Page gave his affidavit, and the Court denied preliminary injunctions and the cases were all—never went to final issue, were settled or something happened to them, and in line with that same situation I offer an affidavit of Walter Logan Page, filed in the said case No. 37 of Warren Brothers Company versus County of Allegheny, and ask that it be marked Defendant's Exhibit No. "A–3."

Mr. LYMAN.—It being understood, of course, that everything you offer is just simply for the

purpose of showing what was before the Court and not as evidence of any fact stated.

Mr. LILJEQVIST.—Yes, to show the disposition the Court made of the matter.

Mr. LYMAN.—That is perfectly all right.

The COURT.—It certainly would not be competent evidence of any fact stated in it. If it is competent at all it is only for the purpose of showing that there was such an affidavit before the Court in the Allegheny case.

Mr. LILJEQVIST.—Well, how are their records competent? I am offering this in the same way and for the same kind of a purpose that they have offered their records.

Mr. LYMAN.—If that is just understood, if your Honor please, and not to be used later on, I haven't any objection.

Mr. LILJEQVIST.—I will make the same offer as they introduced for the purpose of meeting the kind of evidence they offered.

The COURT.—I don't understand that the plaintiff is offering the record in any of these other cases as proof of any fact appearing in testimony. [944—391 (a)]

Mr. LILJEQVIST.—I offer the affidavit of Waller Logan Page filed in the Allegheny County case, the issues of which were the same as the case at bar, for the purpose of showing that the complainant, Warren Brothers, were unable to secure a preliminary injunction in that case, as Judge Clark states they were unable to secure in other cases after that affidavit was filed; and for the

purpose of showing what was before the Court in the Allegheny case in the denial of the motion for preliminary injunction, showing that the Court did not have the opinion that the Court had in the Owosso case or in the New York case.

Mr. MONTAGUE.—I think our objection is already registered.

Mr. LYMAN.—I certainly object to any affidavit of Logan Waller Page or anybody else put in this court for the purpose of being treated as evidence of anything it contains without our having an opportunity to cross-examine.

The COURT.—It is all in the record.

Mr. LILJEQVIST.—I wish to save an exception and have it marked as an exhibit under the rule.

(Thereupon, the document last above referred to was marked Defendant's Exhibit "A–3.")

Mr. LILJEQVIST.—And I also offer in evidence for the same purpose certified copy of the affidavit of Waller Logan Page given in the case of Warren Brothers Company, complainants, versus the City of Cincinnati, No. 37, in the United States District Court for the Western District, which is referred to in the affidavit filed in the Allegheny case and made a part of this affidavit. [945—392]

Mr. LYMAN.—Do you say for the same purpose? It is not as evidence of any fact stated in it.

Mr. LILJEQVIST.—Well, I stated the same purpose as before.

Mr. MONTAGUE.—He is offering it for the purpose of not only showing the facts stated in it, but

that those facts influenced the Court and we submit it is entirely improper for that purpose.

The COURT.—I don't think it is competent. I don't think you can make testimony that way. It may have been considered by the Pennsylvania court sufficient to justify it or inducing it to refuse an injunction, but that wouldn't be any evidence of any fact in this court.

Mr. LILJEQVIST.—Now, for the purpose of explaining the record in the Cincinnati case referred to, I wish to file a certified copy of the agreement settling that case, showing it was a consent decree and therefore decided nothing so far as the issues were concerned.

Mr. LYMAN.—Nobody said that it decided anything, except that the decrees were entered.

The COURT.—That is the one Mr. Warren testified to on the stand?

Mr. LYMAN.—Yes.

Mr. MONTAGUE.—Is your offer made now?

Mr. LILJEQVIST.—Yes, I made that offer.

Mr. MONTAGUE.—The Court now admits in evidence the certified copies which have been offered showing the complaint, answers and decree in these cases, and excludes the other papers, is that right? [946—393]

The COURT.—Yes.

Mr. LILJEQVIST.—We save an exception.

Mr. LYMAN.—We also object to this piecemeal offer of these records, the selected parts, and want the rest of them.

The Court.—I think if it is to be a proceeding in

the other case persuasive at all, I think the Court ought to have the entire record.

(Affidavit of Logan Waller Page and final decree in Warren Bros. against City of Cincinnati, U. S. District Court, Southern Ohio, Western Division, was thereupon marked Defendant's Exhibit "A–3½.")

Mr. LILJEQVIST.—Now, for the purpose of showing that the Warren Brothers have made in previous cases a different claim to what they contend the alleged discovery and alleged invention of John Frederick Warren was, I offer in evidence a certified copy of the affidavit made by George C. Warren, president of Warren Brothers Company, in the United States District Court for the Western District of Pennsylvania wherein Warren Brothers is complainant and the County of Allegheny and others were defendants, being Number 37.

Mr. MONTAGUE.—We object on the ground it is immaterial—

Mr. LILJEQVIST.—(Interrupting.) And in which affidavit the President of the Warren Brothers Company stated as follows:

"Affiant further states that prior to the invention of F. J. Warren covering the construction of a street pavement by the use of different sizes of stone, combined in such proportion as would reduce the voids in the mineral aggregate below twenty-one per cent and thereby produce in the mineral aggregate a useful degree of stability independent of the cementing material used, there were only three kinds of [947—394] monolithic

street pavement known to the paving art, the ordinary macadam, so-called tar macadam, and the standard asphalt pavement, the three former being made by laying the different sizes of stone in layers, the coarser at the bottom and finer at the top, and the latter by the use of sand which has no stability, mixed with an asphalt cement.

"Affiant states that the addition F. J. Warren made to the paving art, which is covered by his several patents, was that he provided for the use of several sizes of stone so graded and proportioned as to reduce the voids in the mineral aggregate below twenty-one per cent, thereby producing a useful degree of inherent stability to resist vehicular traffic, independent of the cementing material used. This method of constructing the wearing surface of a street pavement had never been successfully accomplished prior to the application of the patents now owned by complainant.

Mr. LYMAN.—Well, go ahead and have it in. We will be glad to have it in, so far as that is concerned.

(Certified copy of affidavit of George C. Warren in United States District Court, Western District of Pennsylvania, in the case of Warren Brothers Company vs. County of Allegheny, et al., was thereupon received in evidence and marked Defendant's Exhibit "A–4.")

Mr. LILJEQVIST.—Now, for the purpose of explaining, and that purpose only, what Judge Clark referred to in the case of Warren Brothers Company versus Pace Brothers, I offer a certified

copy of the affidavit of Samuel M. Pond and of Waller Logan Page used in that case. [948—395]

Mr. LYMAN.—I can't believe that counsel is doing this in good faith—

The COURT.—I think the objection is well taken, absolutely well taken. You can't explain the decision of the Court by one particular piece of evidence.

Mr. LILJEQVIST.—It is included in their record that they have already included, may it please the Court, which I have objected to except for limited purposes. Now, I am offering just a portion of what they themselves have already in evidence.

The COURT.—Why do you want to cumber the record if it is already in?

Mr. LILJEQVIST.—But I don't admit its validity for the general purposes for which they attempt to introduce it in that case.

The COURT.—Well, the objection is well taken.

Mr. LILJEQVIST.—As I stated, only for the purpose of explaining what Judge Clark meant by his decision.

Mr. LYMAN.—The whole record is before your Honor anyway.

Mr. LILJEQVIST.—Will you permit me to introduce that part of your record?

The COURT.—It is already in evidence.

Mr. LYMAN.—It is all in evidence long ago.

Mr. LILJEQVIST.—And yet you object to this.

Mr. LYMAN.—Because you have some ulterior purpose in putting it in.

The COURT.—It isn't any proof of any facts stated in that. You can't make a record that way, not according to my understanding of the law. [949—396]

Mr. LILJEQVIST.—I will be as brief as I can. I wish to save an exception and ask to have it marked defendant's exhibits.

(Thereupon, the last two documents referred to were marked Defendant's Exhibits "A–5" and "A–6").

Mr. LILJEQVIST.—I offer in evidence, may it please the Court, the bill of complaint to show the issues and the order showing the denial of the motion for preliminary injunction, the final decree issued, all duly certified by the Clerk of the Court, with a certified copy of the docket entries in the case of Warren Brothers Company versus South Park Commissioners and Metropolitan Engineering & Construction Company, Northern District of Illinois, Eastern Division, for the purpose of showing that that Court had before it the identical question that this Court has before it, and denied a preliminary injunction and the case was dismissed at complainant's cost.

The COURT.—That is, the Court declined to issue an injunction?

Mr. LILJEQVIST.—Yes.

The COURT.—That might be based upon a good many considerations.

Mr. LILJEQVIST.—Yes, sir.

The COURT.—That is discretionary with the Court.

(Whereupon, the document last referred to was marked Defendant's Exhibit "A–7.")

Mr. LILJEQVIST.—I offer in evidence a certified copy of the order denying the motion for preliminary injunction in the case instituted in the Circuit Court of the United States for [950—397] 5–3 District of Indiana, wherein Warren Brothers Company was complainant and Marion County Construction Company and others were defendants, No. 11082, in Chancery; certified copy of the order dismissing the bill of complaint at complainant's cost, and the certified copy of the docket entries in that case, together with the opinion of Judge Anderson, rendered in that case, which is not certified, but which Mr. Montague and I conferred about and he said he would not insist upon my producing a certified copy of that opinion.

Mr. MONTAGUE.—That is merely remarks under a preliminary injunction; I don't consider that an opinion. But this all goes in under the objection.

The COURT.—Yes.

(Said document was thereupon marked, over the ruling of the Court, Defendant's Exhibit "A–8.")

Mr. LILJEQVIST.—They have offered some evidence that the surety company settled, and we now offer certified copy of the record in the Circuit Court of Appeals in the Pace case, to show what happened in that case, and ask that it be marked defendant's exhibit.

(Said record so offered was thereupon received in evidence and marked Defendant's Exhibit "A–9.")

Mr. LILJEQVIST.—Now, we offer in evidence, may it please the Court, a work entitled "Foundations and Concrete Works," by E. Dobson, A.-M. I. C. E., Fifth Edition, Published London, Crosby Lockwood and Co., 7, Stationers' Hall Court, Ludgate Hill, 1881, at page 40.

Mr. LYMAN.—Page 40? [951—398]

Mr. LILJEQVIST.—It is very short. (Reading:)

"Concrete is made of gravel, sand, and ground lime, mixed together with water; the slacking—"

Mr. LYMAN.—(Interrupting.) Does it appear that this is hydraulic cement concrete that it is dealing with?

Mr. LILJEQVIST.—Oh, yes. (Continuing reading:) "—the slacking of the lime taking place whilst in contact with the sand and gravel. It is difficult to give any definite proportions for the several ingredients; but the principle to be followed in proportioning the several quantities of sand and stones should be to form as much as possible a solid mass, for which purpose it is desirable that the stones should be of various sizes, and angular rather than rounded. The common material is unscreened gravel, containing a considerable portion of sand and large and small pebbles; but small and irregular fragments of broken stone, granite chippings, and the like, are of great service, as they interlace each other, and bond the mass together. The proportion of lime to sand should be such as is best suited to form a cement to connect the stones. This must depend in a great measure

on the quality of the lime used; the pure limes requiring a great proportion of sand, whilst the stone limes, and those containing alumina, silica and metallic oxides, require a much smaller proportion."

Mr. LILJEQVIST.—I understand that our interpretation of the stipulation entered into between the plaintiff and defendant is that where we produce the book and it has the date of publication on it that is *prima facie* correct, it is not vouched for by counsel—so there won't be any question about the date of publication. We have not tried to bring the people from all over the country or get the deposition to prove the date of publication of these things. [952—399]

Mr. LYMAN.—No, that is all right.

Mr. LILJEQVIST.—We offer in evidence a portion of the report of the Commissioners of the District of Columbia, at page 137, found in the volume entitled "Exceptive Documents, Second Session, Forty-seventh Congress, 1882–83, volume 14."

Mr. LYMAN.—Is that in your answer? Where is it in your answer?

Mr. LILJEQVIST.—I am introducing this merely as prior art. I had it in anticipation, and withdrew it; simply to indicate, as far as the record is concerned, what the condition of the art was at that time, and for no other purpose. (Reading:)

"The concrete pavements laid prior to 1878 were composed of broken stone, pebbles, sand and powdered stone, cemented by some of the bituminous

products resulting from the distillation of coal tar. These products slowly volatilize in the air, resulting in a gradual disintegration of the pavement; hence they are inferior to the asphalt of Trinidad as a cementing substance, and they are no longer used in our new pavements. Many of these pavements, however, have made very durable roadways; that on K Street, for example, being in excellent order after seven years' wear without any repairs; others were of an inferior character. It was thought a few years since that they were all in danger of destruction and would soon be worthless, but it has since been shown that by careful repairs, each small in amount but executed promptly by skilled workmen under the supervision of inspectors of long experience in the class of work, they can be made to last for several years to come; and that even when the top surface is completely worn off and can be patched no longer, the base still remains of durable material on which a new top coat can be laid, making the pavement almost as good as new. An appropriation of $50,000 has been annually made for the specific purpose of keeping [953—400] these pavements in good order, and a similar appropriation is asked for the next year. As we have about 32 miles of these pavements, with a superficial measurement of 750,000 square yards, all of which are kept in order with the $50,000, the average cost per square yard is between six and seven cents per year. This includes every expense necessary for keeping them in thorough repair, besides resurfacing about 20,000 yards each year, and it is

certainly not a heavy charge for the luxury of smooth pavements. The cost to the contractors of keeping the new asphalt pavements in repair is, as far as can be learned, between one and two cents a yard annually." That is the 1882.

Now, I offer in evidence a portion of the report of the Commissioners of the District of Columbia, found on page 709, published by the Government Printing Office in the year 1895, found in "House Documents, Volume 24, No. 7, District of Columbia, Report, 1895." (Reading:)

"Considerable change has been made during the past year in asphalt pavement by the addition of a fine sand to a sand similar to that formerly used. This combining of sands is not to be commended, owing to the nonuniformity of the resulting mixture; but under the present circumstances it is the best that can be done as there is no suitable fine sand available. The only fine sand now available is that dredged off the foot of Seventeenth Street. Its character and mesh composition well adapts it to asphalt paving, but being a dredge sand it is, as a consequence very wet, and if used separately great difficulty would be experienced in heating it by method in use. This could [954—401] be overcome to a great extent by keeping large quantities in stock thus allowing the water to drain and dry out of it. But thus far the consumption has kept pace with the supply. This change in sand has been made not only on a theoretical study of sand void, but on a practical study of the older pavements; comparing those which have been down

from ten to eighteen years with those of recent date. The following table is given to illustrate this": Then the table there is, which I am omitting, simply the composition of sand, showing the gradations of it.

And again, on page 710: "Asphalt binder. Great improvement can be noted in the binder mixture as laid at the present time over that of last year. This improvement is due to the addition of smaller stone and dust, to a limited extent, to the old one-sized binder stone. This change is very marked and well illustrates the importance and necessity of a thorough study of the character and grade of stone or sand to be used with asphalt in the manufacture of pavements."

Now, although there is some evidence tending to show that the invention was made in the year 1900, the application not being filed until 1901, I wish to offer in evidence a portion of the report of the Inspector of Asphalts and Cements, being the operation of the engineer department of the District of Columbia, found on page 127, published September 11, 1900, found in a book entitled, "Report of the Commissioners of the District of Columbia for the year ending June 30, 1900"; also entitled "House Documents, Volume 44, No. 7, District of Columbia, Report, 1900." [955—402]

"Binder Stone—The stone most commonly used is obtained by crushing the Potomac gneiss so that it will all pass a 1¼ inch screen. As this stone crushes with a considerable dust, a small portion of the dust is removed, otherwise it is used just as it

comes from the crusher. To this stone is also added the coarse material screened from the wearing surface sand.

"It is our practice here to use an aggregate in the binder that is graded from coarse to fine, as we find with such material that a soft asphalt cement can be used and yet obtain a tough, compact binder that will have, after rolling, a honeycombed surface.

"Having now given a short description of the various materials that go to make up the various parts of the asphalt pavement, the next step is the proper mixing and handling of the materials to produce the binder and wearing surface.

"The binder is made by mixing the binder stone, just described, with asphaltic cement in such proportion that the finished binder contains about 5 per cent of bitumen. The asphalt cement used in the binder is much softer than that used in the surface mixture. The advantage of this will be discussed later on. In the case of Trinidad asphalt the cement is made of a consistency of 70 to 80 penetration. To accomplish this, 28 to 39 pounds of residuum oil are used to flux 100 pounds of refined asphalt into cement. When Bermudez asphalt is used the cement is of the consistency of 80 to 90 penetration, which requires anywhere from 25 to 35 pounds of residuum oil to the 100 pounds of refined Bermudez, depending on the quality of the refined. [956—403]

"The stone is passed through heating drums where it is heated to a temperature of about 300° F. The asphalt cement is melted and kept at a tempera-

ture of 300° to 325° F. in a tank from which it is either drawn off or dipped, as the case may be, into the mixer, where it is thoroughly incorporated with the heated stone. After being thoroughly mixed the binder is dumped from the mixer into the wagon. This mixing takes about three minutes in the ordinary mixer. It is impossible to establish an exact formula for the amount of asphalt cement to add to each batch, owing to the variation of the stone, and the only rule to follow is to watch the material in the mixer and keep adding cement until each stone is completely coated with cement.

"The binder should look glassy, and each stone should be entirely covered with a thin coating of cement. There should be no appearance of any excess of cement in any portion of the binder. It must not appear dull, although a binder will sometimes present a dull appearance when viewed from a distance, caused by the presence of considerable dust. On close examination, however, the stone will be found well coated, but will have a rough appearance, due to the fine particles in the cement.

"It is a mistaken idea possessed by some that the binder stone should be screened clean and be free from all fine material. When such a binder is laid the stone in it will only be cemented at the point of contact which is a very small area in most cases, especially where the stones are angular and all of one size. Such a binder is insecure, and the stones are liable to shift their position from traffic [956a—404] passing over the pavement. It is also necessary with stone free from fine material to

use a harder cement than otherwise, so as to make a sufficiently firm bond between the stones. It is my opinion that a very soft cement in the binder is an advantage, as it prevents, to a certain extent, the drying out or hardening of the wearing surface. With a stone that is graded from coarse to fine, and it can even contain considerable fine, a most substantial binder can be made with a soft cement, and still be sufficiently honeycombed to admit of a keying into it of the wearing surface.

"The point will naturally be raised that a binder containing fine stone will take more asphalt cement, owing to the greater surface area, than a screened stone binder, and thus be more expensive. This is true, but not to so great an extent as would first appear, for the asphalt cement being so much softer, its coating on the stones will not be as thick as in the case where a harder cement is used."

"Asphalt wearing surface.—As this is the portion of the pavement that is directly exposed to the wearing of traffic and the influence of the weather, it is very essential that the greatest care should be exercised in its manufacture and laying, not alone in the selection of the materials, but in the keeping them uniform and uniform handling. A pavement seldom, if ever, goes to pieces as a whole, but starts in some one place, disintegrating from it. That place is the weakest point in the pavement and could not exist if the materials and work were absolutely uniform throughout. [957—405] Of course this is an impossibility, but with good ma-

terials the man that treats them most uniformly is the one that will produce the best pavement.

"The asphalt wearing surface is made by mixing heated sand with heated asphalt cement. The sand used, as I have before mentioned, is generally composed of a mixture of two or more sands and sometimes stone dust. This mixing is done while the sands are still moist from the bank and can be accomplished with little care, as wet sand does not tend to separate. The sand of the desired composition obtained by this mixing is then passed through revolving heating drums and heated to a temperature of about 330° F., after which it is passed through a screen that takes out all material coarser than a 10-inch mesh. It is then conveyed to a sand bin, from which it can be drawn into the measuring box. After the sand becomes dried, its handling becomes a much different problem than the handling of wet sand, and great care and forethought must be exercised to prevent its separating itself. An illustration of this which is familiar to everyone is, when dry sand falls, forming a conical pile the coarse grains roll down the side of the pile, leaving the fine in the center and top of the pile. It is now impossible to get samples from different parts of this pile that will be the same in mesh composition.

"The asphalt cement for the wearing surface should be, if Trinidad, for ordinary work, 45 penetration; if Berdmudez, it should be 55 penetration. It should be kept in the supply tank at a temperature of about 310° F., and constantly [958—406] agitated. Thorough agitation here is very essen-

tial to prevent any subsidation that might take place, so as to keep the composition of the cement uniform.

"As asphalt cement when kept at a high temperature slowly hardens by evaporation and oxidation, it is important that the temperature in the dipping or supply tank be kept as low as practicable, and after the cement has been subjected to a prolonged heating it should be examined and a proper quantity of residuum oil added to bring it to its original consistency. The hot sand, which will not have a temperature of about 325° F., is drawn from the bin into the measuring box, where it is either struck off with a straight edge or weighed, as the case may be. Into this box is also added the powdered limestone while the sand is running in, so as to get a slight distribution. The sand is then run into the mechanical mixer, where it is mixed for about half a minute to insure uniformity throughout. A measured amount of molten asphalt cement of a temperature of about 310° F. is then added to the sand in the mixer and the whole mixed for longer than two minutes, but not over five minutes, when it is dumped into a cart and is ready for the street. The temperature of the mixture as it falls into the cart is generally 300° F. About 20° F. is lost in temperature in hauling the mixture to the street to a distance of a mile, with the atmospheric temperature 60° F.

"Laying of the pavement.—Asphalt pavement of the types that are being laid in this city are composed of three distinct parts, the base, binder, and wearing surface. [959—407]

"The base is usually constructed of concrete made of 1 part natural cement, 2 parts sand, 2 parts gravel, and 3 parts stone laid to the depth of 6 inches, and finished with its surface parallel to the grade of the pavement. If a base with these proportions is thoroughly mixed and properly laid, it should give a fairly rough surface, which is very desirable so that the binder will key into it, thus minimizing the possibility of the pavement being shoved by traffic.

"An old cobble, granite block, macadam, or any old pavement that has been well settled marks very good base, and all such that have been so utilized here have proven entirely satisfactory. In the case of cobble or granite block pavements the surface is prepared by cleaning out the joints and filling all depressions with broken stone, which are sprinkled with asphaltic cement to make them more rigid and give a surface that the binder will the better adhere to.

"The macadam pavement is prepared by thoroughly cleaning and removing all soft material and spreading over the surface a layer of broken stone, which is sprinkled with the asphalt cement as described above.

"When an old asphalt pavement is utilized for a base and it is desired to lay the binder directly on it, the surface should be gone over with a pick to roughen it, thus giving a better surface for the binder to adhere to.

"The binder, which is brought from the paving yard in carts, is spread over the finished base, of

whatever character it may be, and raked to an even depth of 2 inches, after which it is gone over with a steam roller until it is thoroughly compressed. [960—408]

"To prevent the binder from adhering to the roller, jets of water are so arranged that while in motion the roller is sprayed.

"The binder when completed should present a surface that is markedly honeycombed. It should at the same time be so firm that it will stand hauling over without being displaced. It should, as a general rule, appear glossy, but, as before explained, it sometimes has a full appearance, owing to the presence of considerable fine material.

"It sometimes occurs, owing to the binder being too rich, that the cement will settle to the bottom of the cart while hauling to the street. When this material has been spread it will appear as a rich place in the surface of the binder, and care must be taken that all such places are cut out and discarded or they will cause a softening of the wearing surface and subsequent failure of the pavement at that place.

"If binder appears dull and on laying the stones show no tendency to adhere together, the binder should be removed and replaced by good material.

"Wearing surface.—The surface of the binder should be swept as clean as possible before laying the wearing surface. This is very important, as any foreign material on the binder will prevent thorough adhesion of the surface mixture to the binder.

"The asphalt mixture which composes the wearing surface is spread and raked similar to the binder to an even depth of 2½ inches." [961—409]

I think that is all. It describes what it was.

We offer in evidence the definition of asphalt pavement found in Knight's "New Mechanical Dictionary," published by Houghton, Mifflin & Company, New York, 11 East Seventeenth Street, Riverside Press, Cambridge, 1884. Page 50: (Reading:) "Asphalt pavement—Asphalt is limestone saturated with bituminous matter."

We offer in evidence a portion of an article published in the "Scientific American Supplement No. 993," found on page 15,867, published January 12, 1895, by Ernest L. Ransome, entitled "Concrete Construction."

Mr. LYMAN.—This is dealing with Portland cement?

Mr. LILJEQVIST.—This is dealing with Portland cement. (Reading:) "A first-class aggregate should be made of hard, tough rock, free from clay or dirt, and having a rough surface and sharp angles when broken. It should be so graded from the finest grains to the largest pieces admissible in the work it is for, as to give, while retaining the largest proportion of largest size pieces, the smallest proportion of voids."

We also offer in evidence an article entitled "Practical notes on concrete," read before the Ohio State Engineers' Society at the annual meeting, Cincinnati, January 17, 1895, published in "Scientific American, Supplement No. 997," on February

9, 1895, commencing in said number at page 15,933. We have a complete copy of it, and we would offer it in evidence, to save the reading of the whole article. I would like to just call the Court's attention to a material part.

Mr. LYMAN.—(Interrupting). That is also dealing with Portland cement, is it?

Mr. LILJEQVIST.—Yes, I think so.

(Said copy of article so offered was thereupon received in evidence and marked Defendant's Exhibit "A–10.") [962—410]

Mr. LILJEQVIST.—I wish to read a small portion of it. (Reading:)

"The chief object in compounding concrete is to produce a compact mass, as free as possible from pores or open spaces; in short, to imitate solid rock as closely as possible. Cement is the 'essence of rock' in portable form, and by its judicious use granular or fragmentary materials may be bound together into solid blocks of any desired size and shape, which in strength and wearing qualities are at least equal to the best stone that comes from the quarries. Cement is, however, very costly in comparison with the other ingredients of concrete, and must not be used wastefully. A little cement, judiciously used, is better than a large quantity, thrown in recklessly, as a little study of the principles involved will plainly show.

To produce a compact mass from fragmentary materials, the voids must be filled. Imagine a box holding one cubic foot. If this were filled with spheres of uniform size, the voids or open spaces

would be one-third the total volume, or thirty-three and one-third per cent; with spheres of various sizes, as for example, from large marbles down to small shot, the voids would be much less, and it would theoretically be possible, by the use of spheres of graded sizes, from the largest down to dust of infinite fineness, to fill the box completely, so that there would be no voids whatever. In practice it is well known what the use of materials of varying fineness gives the best concrete, since the voids are much less in materials composed of pieces of uniform size. [963—411] Hence, the common practice of making concrete with cement, sand and broken stone, instead of with cement and sand or cement and stone only. The sand fills the voids, and if the proportions are correct, a practically solid mass results.''

The entire article is offered.

Now, we offer in evidence Chapter IV, entitled ''Composition of Road Coating,'' of a work entitled ''The Maintenance of Macadamised Roads, by Thomas Codrington, M. Inst. C. E., F. G. S., etc., formerly General Superintendent of County Roads for South Wales, Second Edition, Revised and Enlarged, E. & F. N. Spon. 125, Strand, London. New York, 12 Cortlandt Street,'' published in 1892.

We have a compared copy of this chapter, which we would offer in evidence, to save reading the entire chapter at this time, and I wish to call the Court's attention to the following portion: (Reading:)

"Stone, when broken to a size fit for road material, is more bulky, weight for weight, than either the solid rock or the quarried stone from which it is derived. The late Mr. C. W. Merrifield, F. R. S., noted that assuming that none of the faces are concave, and that there are no built-up hollows, broken stone cannot lie looser than when all the pieces are of the same size and shape and are regular tetrahedrons, and when that is the case he showed that half the space is filled and half void. Experiments confirm the conclusion thus arrived at. Herr Bolkelberg states that he found that broken stone, averaging in size from [964—412] 3¾ cubic inches in some experiments to and from 4 to 6 inches in others, consisted very nearly of half solid and half empty space, the rounded stones packed closer than angular ones, and left less void, and that by packing irregularly shaped broken stone in a chest the empty space could be reduced to as little as 40 per cent of the whole. As a general result the size of the stones was without sensible influence on the proportion of the empty space if the stones were of an even size, but stones of various sizes mixed together gave a smaller proportion of void, which diminished as the variety in the size of the stones was greater."

(Said copy so offered was thereupon received in evidence and marked Defendant's Exhibit "A–11.")

Mr. LILJEQVIST.—We have a couple of other publications which we will offer and put a witness on in connection with; the Specification No. 62 of

the city of Los Angeles, which counsel heretofore stated he had no objection to, I think.

Mr. LYMAN.—That was in the Owosso case.

Mr. LILJEQVIST.—Yes.

Mr. LYMAN.—And printed in the Owosso record.

Mr. LILJEQVIST.—Yes.

(Said specification so offered was thereupon received in evidence and marked Defendant's Exhibit "A–12.")

Mr. LILJEQVIST.—I would like to offer in evidence the articles by Sudcliffe and Dobson and Potter, which were offered in evidence in the records which you have introduced copies of, which were set forth in the dates of former publication, as evidence in this case. [965—413]

Mr. LYMAN.—That is all right. You ought, however, to have copies of them made to be put into this record.

The COURT.—Yes.

Mr. LYMAN.—So that your Honor can see them.

Mr. LILJEQVIST.—I will do that then.

Mr. LYMAN.—Which are the ones?

Mr. LILJEQVIST.—The article by Dobson.

Mr. LYMAN.—That is the one you read already.

Mr. LILJEQVIST.—There is another one there; there is one by Potter & Sudcliffe.

Mr. LYMAN.—The first one you put in was by Dobson, as I remember it.

Mr. LILJEQVIST.—That is the article by Sudcliffe, and one by Thomas Potter, and then there was another one there.

Mr. LYMAN.—Well, I should suggest that you give copies of just what you are going to put in, so that we will know what they are. [967—413 (a)]

Defendant thereupon offered, among other patents not relied upon in this appeal, the following patents which were received in evidence, to wit:

BRITISH PATENTS.

Number.	To Whom Issued.	Date.	Dft.'s Exhibit No.
13,168	James Ward	1900	A–13
771	S. G. Gregg and Daniel Evans	1872	"
13,169	Ward	1900	"
610	John Henry Johnson	1872	"
1,940	Andre Bresson	1873	"
1,315	Macomber	1871	"
1,743	Newton	1871	"
379	King	Jan. 30, 1879	"
1,568	Henson	Oct. 29, 1873	"
33	Van Camp and Clark	Jan. 2, 1874	"
5,652	McNeill	1828	"
11,380	Couillard and McKeown	1880	"

CANADIAN PATENTS.

2,633	Nathan Abbott	Aug. 12, 1873	A–13

Photostatic copy of Canadian Patent Office record of No. 2633, Nathan B. Abbott, Brooklyn, N. Y., U. S. 12th August, 1873.

Photostatic copy of Canadian Patent Office record of Patent 11,380, "Improvement on concrete pavement," issued June 14, 1880, for five years.

UNITED STATES LETTERS PATENT.

44,589	Richard Atkinson	Oct. 11, 1864	A–13
69,738	Russell Fisk	Oct. 8, 1867	"
86,355	J. Warren Brown	Feb. 2, 1869	"
93,142	A. Van Camp	July 27, 1869	"
97,088	Frank N. Hopkins	Nov. 23, 1869	"
98,522	Evander W. Ranney	Jan. 4, 1870	"
104,325	Gabriel Leverich & Albert H. Emery	June 14, 1870	"
111,151	Samuel R. Scharf	Jan. 24, 1871	"
112,764	Nathan B. Abbott	Mar. 21, 1871	"
165,530	Henry B. Bellamy	July 13, 1875	"
169,005	William H. Jones	Oct. 19, 1875	"
174,648	Aaron Van Camp	Mar. 14, 1876	"
176,360	Samuel R. Scharf	Apr. 18, 1876	"
187,926	Stafford & Phillips	Feb. 27, 1877	"
211,313	W. W. Averell	Jan. 14, 1879	"
262,133	A. L. Scott	Aug. 1, 1882	"
302,679	J. E. Wynkoop	July 29, 1884	"
330,196	A. L. Barber	Nov. 10, 1885	"
330,197	A. L. Barber	Nov. 10, 1885	"

[968—414]

Number.	To Whom Issued.	Date.	Deft.'s Exhibit No.
348,880	W. W. Averell	Sept. 7, 1886	A–13
394,126	W. C. Murdock	Dec. 4, 1888	"
394,583	George S. Lee	Dec. 18, 1888	"
607,884	Clifford Richardson	July 26, 1898	"
675,694	Samuel Whinery	June 4, 1901	"
695,421	Frederick J. Warren	Mar. 11, 1902	A–15
220,234	Samuel E. Gross	Oct. 7, 1879	A–13½
254,366	Antonio Peffetier	Feb. 28, 1882	"

Thereupon defendant offered in evidence the following patent issued to Frederick J. Warren for the purpose of showing Warren's interpretation of the patent 1901 and his interpretation of the patent 1903 for the purpose of constituting an estoppel by him after the issuance of the patent of 1901 and an admission by him as having covered the field of what he calls inherent stability in the patent of 1901; and furthermore by series of patents subsequently issued to him as showing an attempt on his part to corral the art and prevent the use of mineral ingredients in combination with plastic binder.

To this offer complainant objected as to any patent subsequent in date to the patent in suit offered for any such purpose or to show that Warren was trying to corral the art, and objected to as wholly immaterial to any issue in the case.

Subject to said objection the following patent was offered and received in evidence:

695,423 Frederick J. Warren March 11, 1902 A–15

Defendant waived the defense of double patenting set up in the answer with reference to patent 695,421 issued March 11, 1902, to Frederick J. Warren. [969—415]

Patent 675,430 dated June 4, 1901, to Frederick J. Warren was offered and received in evidence and marked Defendant's Exhibit "A–14."

For the purpose of showing Frederick J. Warren's interpretation of patent 675,430 and for the purpose of showing by his statements in subsequent patents that he understood and interpreted the said patent 675,430 as covering his theory and claim invention

of inherent stability, and for the purpose of showing admissions by him in reference to what he claimed was covered by said patent of 1901, for the purpose of constituting an estoppel against him from claiming any further invention after the application for this patent was filed or the patent was issued, and for the purpose of showing that Frederick John Warren attempted to corral the art and to prevent the use of any combination of mineral materials and a plastic binder as a wearing surface for all pavements, defendant offered in evidence the following patents:

695,422	Frederick J. Warren	Mar. 11, 1902	A–15
695,421	" "	Mar. 11, 1902	"
771,954	" "	Oct. 11, 1904	"
771,953	" "	Oct. 11, 1904	"
799,619	Frederick J. Warren Ralph L. Warren & Frank G. Cutter, as Administrators	Sept. 12, 1905	"
791,960	" " "	June 6, 1905	"
727,507	Frederick J. Warren	May 5, 1903	"
727,508	" "	May 5, 1903	"
727,509	" "	May 5, 1903	"
727,510	" "	May 5, 1903	"
727,511	" "	May 5, 1903	"

[970—416]

Mr. MONTAGUE.—We object to this offer on the grounds previously stated here—there has been no estoppel set up in the complaint. These patents are all subsequent to 727,505, the patent in suit, and subsequent attempt of John Frederick Warren to

corral the art, as counsel calls it, might amount to misconduct on his part, but would not affect his right to recover in this lawsuit. We consider for these and other reasons that they are entirely incompetent, irrelevant and immaterial.

Mr. LILJEQVIST.—I might add to the offer that we also offer them for the additional purpose of giving John Frederick Warren's interpretation of his 1901 patent, which shows that the 1903 patent was merely double patenting of the 1901.

Mr. LYMAN.—So far as anything in those patents could be used for arguing that question, I would not object to it, would not waste any argument on that. Let it go.

Mr. MONTAGUE.—I understand, your Honor, that they will be admitted, then, for the latter purpose only?

The COURT.—Yes, for the latter purpose.

Patent number 695,421; 695,422; 695,423, 727,507; 727,508; 727,509; 727,510; 727,511; 771,953; 771,954; 791,960; 799,619 were received in evidence and marked Defendant's Exhibit "A–15." [971—416(a)]

Patent No. 715,630, Frederick J. Warren, December 9, 1902 was offered in evidence for the purpose of showing Warren's interpretation of the state of the art with reference to the plastic material at that time and was received in evidence and marked Defendant's Exhibit "A–16."

The file digest of patent No. 293,214 issued to W. W. Averell Feb. 12, 1884 was offered and re-

ceived in evidence and marked Defendant's Exhibit "A–17."

Defendant offered in evidence certified copy of a pamphlet entitled, "Patents for Inventions, Abridgments of Specifications. Class 107, Roads and ways. Period A. D. 1884–88." Published at "London: printed for Her Majesty's Stationary Office, by Darling & Son, Ltd., 1, 2, 3 & 5, Great St. Thomas Apostle EC. Published at the Patent Office, 25 Southampton Buildings, Chancery Lane, London, WC. 1897," the pamphlet of which has been shown you, with the proof of the date of the receipt and filing of such pamphlet in the U. S. Patent Office at Washington, District of Columbia, which document was received in evidence and marked Defendant's Exhibit A–18."

Defendant offered in evidence U. S. Letters Patents No. 382,153 issued May 1, 1888, to Patrick Griffin, which is objected to by complainant for the reason no notice was given in the Answer or otherwise to complainant, which objection was sustained by the Court, exception saved and said patent was offered in evidence by defendant marked Defendant's Exhibit "A–55." [972—417]

Defendant offered in evidence patent No. 114,-172, issued to Frederick E. Matthews April 25, 1871, which was received in evidence and marked Defendant's Exhibit "A–56."

Defendant offered in evidence patents No. 794,-758, Frederick J. Warren dated July 18, 1905; and patent No. 771,952 issued Frederick J. Warren October 11, 1904, for the purpose of showing the in-

terpretation of the complainant in this case and its predecessors in interest of the 1901 patent and the 1903 patent, and the limitations under their own interpretations which can be given to these patents, constituting an estoppel and for the purpose of showing the attempt by the complainant in this case to corral the art; to which offer complainant objected, which objection was sustained by the Court and an exception saved by defendant, and the same were marked Defendant's Exhibit "A–58."

Defendant offered in evidence U. S. Patent issued John Martineau dated August 11, 1834, which patent was received in evidence and marked Defendant's Exhibit "A–59." [973—418]

Testimony of Kenneth S. Hall, for Defendant.

KENNETH S. HALL was called as a witness on behalf of defendant and testified as follows:

Direct Examination.

(By L. A. LILJEQVIST.)

He resides at Salem, Oregon, and is Testing Engineer for the State Highway Commission of Oregon. He is a graduate of Yale University where he took a three years' course in civil engineering. He has had a grammar school education three and one-half years in high school and two years in a preparatory school in Connecticut before going to Oregon. He has been out of college twelve years and has been engaged in the civil engineering and its several branches. His office has been testing engineer for the Highway Commission, about two years and eight months. His duties have

(Testimony of Kenneth S. Hall.)

been to look after all materials of construction used in highway work and look after the mixtures and the laying of pavements of all kinds. Before his connection with the Highway Commission he had a laboratory of his own in Portland where he did inspection work of his own. Mr. Hall took up a sample of the pavement back of McGovern's establishment in Denver, Colorado. It was taken up from a spot of the original pavement shown him by Mr. McGovern. The sample was removed under his direction and he boxed it and personally took it to the express office in Denver, addressed it to himself at Salem where he received it and it was in the same condition in which he took it from the street, the box never having been opened. The sample offered in evidence as Defendant's Exhibit "G" is a portion of this identical sample, which was about two feet square when taken from the street. The rest of the sample was practically the same, as near as witness can tell, as Exhibit "G." Witness sawed this sample. That [974—419] portion of Exhibit "G," which has a chisel mark "H" was the surface of the alley before sample was removed. Hall observed the removing of the sample, it took about twenty minutes or half an hour to remove it from the street. The man who removed the sample used a pick and it was a rather hard job, it was much harder than if it had been of ordinary sheet asphalt. Witness has retained a portion of this sample at his office in Salem, and brought the other into court. Witness made an

(Testimony of Kenneth S. Hall.)

analysis of this sample which has been offered in court, in his analysis he used the top portion of Exhibit "G" exclusive of the fine base, which was not a part of the wearing surface. The fine base was excluded from his analysis. The base is the material which is attached to the sample at the bottom. Witness took a ruler and measured Exhibit "G" and stated that he analyzed that portion extending from the surface to approximately three and a quarter inches in depth. The results of the four tests of Exhibit "G" was as follows:

Passing 1½ inch screen and retained on ¼ inch screen	33.7%
Passing ¼ inch screen and retained on a 200 mesh screen	61.6
Passing 200 mesh screen	4.7
Bitumen	7.7
Voids	20.1

Hall analyzed from the McGovern alley samples secured by F. C. Blake, Defendant's Exhibit "K." It was sawed on one side when he received it and he sawed a side also. The analysis was as follows:

Passing a 3 inch mesh and retained on a ¼ inch mesh	30.9%
Passing a ¼ inch mesh and retained on a 200 mesh screen	64.8
Passing a 200 mesh screen	4.3
Bitumen	7.8
Voids	18.9

Witness visited the city of Washington and took up three samples from the streets there. One sam-

(Testimony of Kenneth S. Hall.)

ple was taken on Pennsylvania Avenue between 25th and 26th Streets on the north side of the street, which witness introduced in court, sample is marked "P." Mr. Beall, who was in charge [975—420] of the surfacing department in the Washington, District of Columbia, and who looked after the streetfaring, was with witness. This is the same man whose deposition was taken.

Q. Will you state to the Court whether that was taken at a point on that street designated by Beall, who has testified in this case?

A. He designated in a general way, and I just took a spot in the pavement and cut it.

Q. Was that a fair sample of the pavement in that vicinity of the street? A. I think it was.

It appeared to be a good sample. Beall showed him this street and the portion of the street from which he took the sample and he made an analysis of it. He analyzed the top portion of the sample offered in evidence, from the surface to the well marked line an inch and a half below the surface. The analysis of this sample, Defendant's Exhibit "A–19," was as follows:

Passing 1½ inch screen and retained on ¼ inch screen	47.9%
Passing ¼ inch screen and retained on a 200 mesh screen	48.3
Passing the 200 mesh screen	3.8
Bitumen	4.6
Voids	11.7

The specimen identified by Mr. Hall, taken from

(Testimony of Kenneth S. Hall.)

Pennsylvania Avenue, Washington, D. C., was thereupon received in evidence and marked Defendant's Exhibit "A–19."

Mr. Hall took a sample from DeSales Street from 17th Northwest and Connecticut Avenue with Mr. Beall.

This sample was offered and received in evidence and marked Defendant's Exhibit "A–20."

It is marked with a chisel mark "D." It was taken up in the presence of Beall by Hall, taken by Hall to the yard of the District of Columbia, boxed up and subsequently shipped to Salem. An analysis was made of the top portion of this sample, an inch or an inch and a quarter. Don't know when this pavement was laid. Analyzed just the top [976—421] surface. The analysis is as follows:

Retained on the ¼ inch	8. %
Passing the ¼ inch and retained on the 200 mesh	89. %
Passing the 200 mesh	3. %
Bitumen	7. %
Voids	22.1%

A very small portion was retained on the quarter inch screen. The larger portions of such material was between the half and quarter inch.

Hall took up a sample on Vermont Avenue between H anl I Streets Northwest, in the presence of Mr. Beall. Hall made an analysis. The analysis is of that portion that contains the finer aggregate immediately below the sheet asphalt top.

(Testimony of Kenneth S. Hall.)

Q. About what length of it below this top—or depth, rather?

A. It varies from, oh, a quarter of an inch to an inch, probably.

A. Well, I mean, how much of the sample did you take for the purpose of analyzing below the sheet asphalt top?

A. Well, I took all except the red sandstone. It was about an inch—it varies, as I say, from a quarter of an inch, and some places about three quarters or half an inch to an inch and a quarter.

Q. The sample itself did?

A. The thickness of it.

Mr. LYMAN.—In order to make the record clear, you might have him—the sheet asphalt surface, he said. Now, what does he mean by "the sheet asphalt surface"?

Mr. LILJEQVIST.—Well, that is very apparent.

Mr. LYMAN.—Well, have him put it on the record.

Q. (By Mr. LILJEQVIST.) What do you mean by "the sheet asphalt surface"?

A. Well, the sheet asphalt surface is the upper inch and three quarters, or such a matter, of the sample. In other words, the present wearing surface of the pavement.

He marked this sample in Washington, D. C., and shipped it to himself at Salem. The analysis was as follows:

Retained on the ¼ inch 39.5%

Passing the ¼ inch and retained on the

(Testimony of Kenneth S. Hall.)

200 mesh screen	51.8%
Passing the 200 mesh screen	8.7%
Bitumen	6.4%
Voids	14.1%

The sample referred to from Vermont Avenue, Washington, D. C., was offered and received in evidence and marked Defendant's Exhibit "A–21."

Mr. Hall called on Mr. Beal, the witness who has testified in this case, at Omaha who showed him several samples of an old pavement laid there, and secured samples from him. He took one sample from an old dump just east of the alley on the north side of G Street between Twenty-fourth and Twenty-fifth Streets. He believes those streets are now called [977—422] South Twenty-fourth and South Twenty-fifth. And the other he got from a wall in front of No. 5214 South 29th Street; that is between Q and R Streets. The sample from the dump is the one marked "O–1." An analysis was made of the whole sample, including what is on top there now. The analysis was as follows:

Retained on the ¼ inch	35.6%
Passing ¼ inch and retained on the 200 mesh screen	60.%
Passing the 200 mesh screen	4.4%
Bitumen	6.4%
Voids	17.6%

The sample was offered and received in evidence and marked Defendant's Exhibit "A–22."

Mr. Hall sawed this sample. The present sawed surface was not in that condition when he got it.

(Testimony of Kenneth S. Hall.)

He has retained a portion of this sample in his possession. He took another sample from a wall in South Twenty-ninth Street between Q and R Streets, of which he analyzed the portion containing the coarser rock, namely that portion below the top inch of the sample, and all the way down to the base. Everything below the line approximately an inch from the surface that was apparently originally the pavement, after scrapping off the dirt naturally that was on it. The analysis was as follows:

Retained on the ¼ inch	46.5%
Passing the ¼ inch and retained on the 200 mesh screen	50.3%
Passing the 200 mesh screen	3.2%
Bitumen	1.4%
Voids	16.25%

This sample of South Twenty-fourth Street, Omaha, Nebraska, taken from the wall on South Twenty-ninth Street between Q and R Streets, was thereupon offered and received in evidence and marked Defendant's Exhibit "A–23."

In making these analyses of the Denver alley, the Omaha and the Washington samples, Mr. Hall made several of [978—423] each; sometimes two, sometimes four and as high as five in some cases. In using the word "analysis" he refers in a rough way to both the void test and the composition. In some cases it depended on the amount of material he had and the size of samples and such as that. The tests in reference to materials he gave them

(Testimony of Kenneth S. Hall.)

are the average of the different tests given. He made a number of analyses and the figures he has given are the result of several analyses. It is not possible to make a single analysis jibe absolutely without a particle of variation from another. It is not possible for any engineer or chemist to do that. The results he has stated are approximately correct. The results he has given he thinks are as accurate as it is humanly possible to make them. In a test of these samples made by several engineers competent to make tests, the variation might by some people be considered considerable but to a man who had this kind of work they appreciate there is a certain error that is allowable in all analyses of all kinds. He described how he made the analyses as follows: First, in case of a sample that is brought us, a foundation of it, the foundation is chipped off as best we can, then the remaining portion, which is the wearing surface, or possibly a few large rocks included, or possibly some of the base, that is all put in a large pan and warmed until the whole sample becomes soft, then any portions of the base are picked out and discarded, and from the remaining portion we weigh out the samples of a thousand grams each; those thousand grams are broken up by hand and are then put into a centrifugal washing machine, which is known as the Rotorex, and to this a solvent is added, [979—424] benzol or chloroform, or carbon bisulphide, or whatever it may be, and the samples—the bitumen is washed out of the samples by centrifugal action; then the remaining

(Testimony of Kenneth S. Hall.)

mineral aggregate is dumped from the bowl into a pan and heated to drive off the volatile solvent, and the whole weighed. The loss in weight on this weighing gives the percentage of bitumen in the sample. Then the mineral aggregate is run through the various screens, and the sizes between each screen weighed, and in that way we get the analysis of the mineral aggregate. Now, that analysis, of course, is based on the whole pavement as a hundred per cent. To get the mineral aggregate alone reduced to a hundred per cent basis, the percentage of bitumen would have to be deducted; adjusting the percentage to a hundred per cent. The sample is separated when the bituminous mortar is softened by the heat, and the rocks are just merely pulled apart. In this method of analysis that he has referred to there is no change in the structure of the mineral ingredients from coarse to dust. The method of screening does not cause grinding away and the formation of more dust. Witness has taken up samples of the Green Springs Mountain Road. He has samples with him, and produces them. Counsel hands witness a sample marked "134" and witness states that is a sample that he took from the pavement on the Pacific Highway in the section known as the Green Springs Mountain Road to California line. This was taken at Station 134, which means that it is 13400 feet from the California line; about two miles and a half. That was laid during the year 1919. Mr. Hall made an analysis of this sample. Witness

(Testimony of Kenneth S. Hall.)

[980—425] figures that the sample which was taken by the plaintiff was approximately Station 190—approximately a mile and a quarter from where Mr. Hall took his sample; further from the California line. Mr. Hall's sample was about two miles and a half from the California line. Plaintiff's samples were one, one mile, and one, 3.6 miles. The analysis made by Mr. Hall of the sample he took is as follows:

Retained on the ¼ inch	50.3%
Passing ¼ inch and retained on the 200 mesh screen	42.9%
Passing the 200 mesh screen	6.8%
Bitumen	7.6%
Voids	18.5%

Witness took the regular screens that they have in their specifications.

Specimen of paving identified by the witness as having been removed from Pacific Highway, Green Springs Mountain, Station 134, was thereupon offered and received in evidence and marked Defendant's Exhibit "A–24."

(Adjourned.)

May 31, 1922.

Testimony of KENNETH S. HALL Continued:

At the request of the complainant in this case witness delivered to them over the holiday the record from which he made up his analysis. He has showed to complainants all the samples he has testified to. They had an opportunity to investigate and examine all with the exception of the sample

(Testimony of Kenneth S. Hall.)

from the Green Springs Mountain Road from the California line section, being Section 134. Mr. Hall took two samples from that road; the other sample taken from Station 71. Witness identifies the sample counsel hands him as the sample he took. It was taken from Station 71 on the Green Springs Mountain Road, California line section [981—426] of the Pacific Highway. 71 is the station number. That would be 7100 feet from the California line.

Thereupon, the sample referred to from the Green Springs Mountain Road, California line section, Station 71, was offered and received in evidence and marked Defendant's Exhibit "A–25."

Mr. Hall made an analysis of that sample, as follows:

Retained on the ¼ inch	49. %
Passing the ¼ inch and retained on the 200 mesh screen	44.9%
Passing the 200 mesh screen	6.1%
Voids	16.4%

The average of the analyses of the two samples taken by Mr. Hall on the Green Springs Mountain Road, was given as follows:

Retained on the ¼ inch	49.5%
Passing the ¼ inch and retained on the 200 mesh screen	43.9%
Passing the 200 mesh screen	6.4%
Voids	17. %

Mr. Hall took up seven samples from the entire Green Springs Mountain Road, some of which pave-

(Testimony of Kenneth S. Hall.)

ment was laid after May 5th, 1920. He made two cuts of the pavement laid before May 5th, 1920. Those are the ones he has testified to.

Mr. Hall made a detailed analysis on the sample taken in the alley back of the McGovern establishment, showing the quantities that passed the various sized screens such as are indicated in the contract involved in this suit. He made four analyses of that sample and the analysis heretofore stated of the McGovern alley sample by Mr. Hall in his testimony (page ——) is the average of the four analyses he made. In making the analysis he did not average it by individual screens but into the grouping given in patent [982—427] number 727,505, and has the details thereof with him. This analysis, which is made by figuring the pavement, including the bitumen, at 100%, is as follows:

	Sample 1	Sample 2	Sample 3	Sample 4
Passing 1½″ and retained on ½″	24.5%	31.0%	23.7%	23.7%
Passing ½″ and retained on ¼″	6.5%	3.9%	4.5%	6.8%
Total passing 1½″ screen and retained on ¼″ screen	31.0%	34.9%	28.2%	30.5%
Passing ¼″ and retained on 10 mesh	21.4%	19.2%	22.3%	21.2%
Passing 10 mesh and retained on 40 mesh	25.2%	23.7%	25.7%	24.7%
Passing 40 mesh and retained on 80 mesh	7.6%	7.4%	8.5%	7.9%
Passing 80 mesh and retained on 200 mesh	2.8%	3.1%	3.2%	3.1%

	Sample 1	Sample 2	Sample 3	Sample 4
Total passing ¼″ screen and retained on 200 mesh screen	57.0%	53.4%	59.7%	56.9%
Passing 200 mesh	3.9%	4.3%	4.6%	4.7%
Total passing 200 mesh screen	3.9%	4.3%	4.6%	4.7%
Percentage of asphalt	8.1%	7.4%	7.5%	7.9%

(Testimony of Kenneth S. Hall.)

Figuring the mineral aggregate at 100%, Mr. Hall gave the following figures of his four analyses of Defendant's Exhibit "G."

	Average
Passing the 1½" and retained on the ¼"..	33.7%
Passing ¼" and retained on 200 mesh screen	61.6%
Passing 200 mesh	4.7%
Bitumen	7.7%

The average voids in the foregoing are 20.1%.

The work sheets giving the analysis which Mr. Hall used, and on which a transposition of figures was corrected on the trial, was offered in evidence and marked Plaintiff's Exhibit 39.

The determination of the voids is purely a mathematical matter, has nothing to do with the aggregate itself, and the transposition of the figures on the work sheets would not alter the percentage of voids, nor alter the percentage of bitumen. Asked to explain this method of figuring the aggregate with the bitumen or without it he stated: In taking our analyses the whole pavement, of course, we figure as a hundred per cent, and that of course includes the bitumen. Now, in order to convert this into the same grading and terms that the patent in suit covers, it is necessary to exclude the bitumen and figure the mineral aggregate at a hundred [984—429] per cent, and that was the way that the figures that I have given are figured, that is, the ones I have grouped together. Taking the mineral aggregate at 100% the percentages given,

(Testimony of Kenneth S. Hall.)

with the corrections, are the correct figures of the analysis of the sample. The voids are 20.1%. In taking the samples in Washington it was very easy to tell whether he took them from a small repair patch or whether it was apparently a part of the old pavement that had been there. There had been no apparent repair, at least for a great many years. The only repair that could have been would be resurfaced, but no patching work. Witness stated he made a detailed analysis of the amount that would go over the different screens, in the Washington sample. The figures which he has given are figures merely of those going over or retained on quarter inch, passing the quarter inch and retained on the 200, and passing the 200. He can give the other figures if asked for them. Witness submitted his analysis on the Washington sample to complainant on Monday. Counsel hands witness a laboratory report and witness states these are reports on samples analyzed by E. W. Lazell. Mr. Lazell was at that time making analyses for the state on the Green Springs Mountain Road. These are official reports filed by him. They are part of the records of the State Highway Commission of the State of Oregon. R. L. Kline is secretary of that Highway Commission. These records are kept by him as secretary. Counsel hands witness a certified copy of this original report, retaining the original for the purpose of comparison on cross-examination. [985—430]

The document last above referred to, being copy

(Testimony of Kenneth S. Hall.)

of original report, was thereupon marked Defendant's Exhibit "A–26."

Witness has written out this record in reference to his tests made on these different streets, tabulated them on paper. He has made the correction through the transposition of the figures on this original. Witness hands a document to counsel, being a tabulation of his testimony.

Thereupon, the document last above referred to, being a tabulation of results testified to by the witness, was marked Defendant's Exhibit "A–27."

On Lazell's official record on the Green Springs Mountain Road about four of the analyses were made from cut samples, cut from the street, and the rest were from samples taken from the plant of the material. The cut samples were identified as follows: Sample No. 13035, taken from Station 502+50, right side, three feet from edge, laid September 3, was cut September 12; Sample No. 12834, Station 481+00, right side, three feet from edge, laid 8/29, cut September 8; Sample No. 12509, station 436 plus 50, L. side, three feet from edge, laid August 18, cut August 20. He knows there was one more cut from the street but he doesn't find it there. All those reports were sent in duplicate to the office. Mr. Hall has one set of files and there is another set of files that Mr. Klein has. In some cases some of those were mislaid or lost. In some cases possibly Mr. Hall has duplicates and there was no copy in the office, and *vice versa*. Mr. Hall will produce the extra analysis made by Lazell

(Testimony of Kenneth S. Hall.)

of the cut section on this identical highway. Mr. Hall stated he [986—431] supervised or assisted in the preparation and laying of a pavement upon a highway recently, using the rock plant used by the contractor in building the roads under contract with the State Highway Commission, at Rowena. He made up a mix of materials under the 1901 patent. He has a sample of that highway.

The file digest of Patent 675,430, granted June 4, 1901, to Frederick J. Warren was offered and received in evidence and marked Defendant's Exhibit "A–28."

Witness used the proportions that are set forth in the patent 675,430 in the laying of that pavement. Witness gives these proportions as follows: between the three inch and the half inch, seventy parts; between the half inch and the ten mesh, twenty parts; between the ten and the forty, twenty parts; between the forty and eighty, four parts; between the eighty and the two hundred, three parts; passing the two hundred, one part. This reduced to percentages is as follows: Between the three inch and the one half 59.3%, between the half and the ten, 16.95; between the ten and the forty,. 16.95; forty to eighty, 3.4%; eighty to two hundred, 2.5%; passing the two hundred, nine-tenths. There was a flush coat sprinkled with sand or fine screenings placed on the pavement. The flush coat shows on this sample, but the screenings were not rolled in when hot. The sample produced does not show the screenings. Mr. Hall made the void test of this

(Testimony of Kenneth S. Hall.)

sample. The void test shows 15.1 per cent. In making his analysis [987—432] for the void test he used all but the base part of the sample; from the line which is about two inches down from the wearing surface is the base; that is the bituminous base. The pavement that he laid under the 1901 patent was laid on a prepared foundation. The prepared foundation consisted of a bituminous mixed base. The base of this sample starts at a point approximately two inches from the top. The side marked "M–2" is the wearing surface. His void test was made of the upper two inches. He did not reduce the materials on that sample to the amount passing a one and one-half inch screen and retained on a quarter inch, and the amount passing the quarter inch and retained on the two hundred, and the amount passing the two hundred mesh. He can do that.

The sample of the pavement laid under patent 675,430 was offered and received in evidence and marked Defendant's Exhibit "A–29."

This sample was taken on the Mosier-Dalles section of the Columbia River Highway. It is part of the highway now being constructed under specifications substantially similar to the specifications involved in this suit. He used the plant which is laying the present highway for the same specifications now in suit. He used materials similar to the materials used in laying a road under specifications similar to that in suit. There is a crusher in connection. The crusher was set so that the largest

(Testimony of Kenneth S. Hall.)

aggregate is approximately two inches. That is the largest stone that we use in road building now, and that is used only in the base. In getting the inch and a half, the larger stuff runs over the inch and a [988—433] half screen in the paving plant and is rejected and hauled back to the material pile, when you are running top. Mr. Dulin assisted Mr. Hall in laying this pavement. Mr. Dulin is chief of the Bureau of Standards of the City of Portland. They laid this pavement under working conditions. The sample produced in court is not a laboratory sample; it is produced under the same kind of working conditions that you meet in laying the patent in suit. He delayed the plant which was laying similar pavement to that involved in this suit long enough to lay this pavement.

Q. Now, state to the Court whether or not you also laid a pavement under similar working conditions under the specifications involved in the case of Warren Brothers against Pace Brothers?

A. I did.

Q. Have you a sample of that pavement?

A. I have.

Q. Will you produce it?

Mr. LYMAN.—How is that material to this case?

The COURT.—I don't know.

Mr. LILJEQVIST.—By the analysis and by inspection.

The COURT.—We are not trying the Pace suit.

Mr. LILJEQVIST.—I know, but, may it please the Court, there is a record of a pavement that has

been held not an infringement, and they have offered that record in evidence.

The COURT.—They have offered that record, as I understand it, to show that this present patent has been upheld.

Mr. LILJEQVIST.—Yes. [989—434]

Mr. DEVERS.—I understood, if the Court please, that the record was offered to show what was before the Court at that time.

The COURT.—Yes.

Mr. DEVERS.—And we are simply offering the pavement to show the pavement that was before the Court at that time.

Mr. LYMAN.—The record in that case shows what that pavement was.

Mr. LILJEQVIST.—Well, I think a visible exhibit is infinitely more illuminating to determine what the Court held in that case, and that is what they are trying to prove.

The COURT.—What did the Court hold,—that that was an infringement or not?

Mr. LILJEQVIST.—Not an infringement.

The COURT.—Not an infringement?

Mr. LILJEQVIST.—Yes, sir, and therefore we think it is very material.

The COURT.—Well, you are taking a very great deal of time on matters, it seems to me, that are quite immaterial in this case. We are not retrying those old cases at all, any of them.

Mr. LILJEQVIST.—I hand you a sample of a pavement and ask you if that was laid under the

(Testimony of Kenneth S. Hall.)

specifications described by the Court in the Pace case?

Mr. LYMAN.—No, just a moment—"described by the Court in the Pace case"—

Mr. LILJEQVIST.—All right; I thought we would shorten it. Describe the materials that went into this pavement? [990—435]

A. The specifications under which I laid it?

Q. Yes, sir.

A. From an inch and a quarter to a quarter—

Mr. LYMAN.—(Interrupting.) We object, if the Court please, to this.

The COURT.—I think the objection is well taken.

Mr. LILJEQVIST.—Wish an exception and offer it in evidence under the statute. Describe the specifications?

A. Inch and a quarter to a quarter, forty per cent; sand, 53 per cent; stone dust, 7 per cent.

Q. Did you make an analysis of this pavement?

A. I did.

Q. What were the voids in it?

A. The voids were 20.9.

Mr. LILJEQVIST.—We offer it in evidence and ask that it be marked defendant's exhibit.

The COURT.—That is pavement laid by you, I understand? A. Yes, sir.

Mr. LILJEQVIST.—Laid under working conditions, was it? A. It was.

Q. With the same plant and the same materials as laying the pavement under the specifications in suit? A. That is right.

(Testimony of Kenneth S. Hall.)

Said specimen identified by the witness as laid from specifications in the Pace case, was thereupon marked Defendant's Exhibit "A–30."

Q. (By Mr. LILJEQVIST.) I hand you herewith a sample and ask you if you laid under working conditions, with the same plant, with the same material, laying pavement similar to the specifications in this suit, a pavement under the materials set forth in the suit of Warren Brothers Company vs. Evans? [991—436]

Mr. LYMAN.—Well, now, that is wholly immaterial, if your Honor pleases.

The COURT.—I think that is wholly immaterial and just taking up the time of the Court.

Mr. LYMAN.—We object to it.

The COURT.—I don't think it could have any possible bearing on the result of this case in trial, and those cases were tried in another court and on the result of those cases they were decided.

Mr. LILJEQVIST.—Well, we expect this to show,—as showing what they have described in their testimony as inherent stability, and these cases have what the—

The COURT.—(Interrupting.) You could take up pavement laid under all the specifications in the United States and have him go out and lay pavement and bring it in here. I have given you lots of liberty in this case, and I am getting somewhat impatient.

Mr. LILJEQVIST.—I have only one more sample, then I am through.

(Testimony of Kenneth S. Hall.)

The COURT.—Put it in as part of the record, but it has no bearing on this case one way or the other.

Q. (By Mr. LILJEQVIST.) Will you state the proportions that went into this pavement?

A. Stone, three-quarter inch, fifty-five to sixty per cent; sand, coarse to fine, thirty to thirty-five per cent; lime dust to Portland cement, four to five per cent; other ingredients, one per cent.

Q. Did you make tests for voids? A. I did. [992—437]

Q. What were the voids? A. 15.9 per cent.

Mr. LILJEQVIST.—Offer it in evidence and ask that it be marked Defendant's Exhibit number blank.

Mr. LYMAN.—Objected to as immaterial.

The COURT.—Objection sustained.

Mr. LILJEQVIST.—Same exception, and ask to have it identified as an offering under the rule.

Said specimen so identified by the witness as laid from specifications in the Evans case, was thereupon marked Defendant's Exhibit "A–31."

Mr. Hall has examined one of the patents made to Averell; the patent in which the proportions were given for the laying of the asphaltic concrete pavement. The number of the patent is 293,314. Witness, with this same plant and under the same working conditions, laid a pavement under the specification described in that patent. In laying this pavement Mr. Hall made it according to the specifications as stated in the patent. He took "fresh water gravel no larger than a pigeon's egg,"

(Testimony of Kenneth S. Hall.)

which is approximately an inch to an inch and a quarter; determined the voids in the gravel by the usual method—this was in quotations, "the usual manner, by the quantity of water which it will hold" —filled the voids with sand, then filled the sand and gravel mixture with asphaltic cement, filled the voids. And added five to ten per cent dust. That is my interpretation of the way he describes it in his patent. Mr. Hall laid that pavement. He identifies sample produced as being a sample of that pavement, marked "M–4." It was laid by [993—438] the same plant and under the same conditions as that testified to with reference to the laying of the other pavements. By the plant now laying pavement under the specifications same as involved in this suit. After it was laid he cut a sample of this pavement, and made an analysis of the sample. In building the pavement he used the water method described in the Averell patent in determining proportions of sand and gravel to use. In other words, before he laid this pavement, he used the method described in the Averell patent. For determining the voids of this pavement on the sample he cut out, he used the usual method of determining on a piece of pavement that is cut from the street. He hasn't described it before. He described it as follows: The specific gravity of that piece of pavement is found by suspending it in water and figured from the difference in the weight; then the sample is taken and analyzed, the bitumen is washed out of it and the material screened.

(Testimony of Kenneth S. Hall.)

From that material that is screened out we usually split it on the ten mesh screen, and we will take the specific gravity from the material retained on the ten mesh and the specific gravity from the material passing the ten mesh; then, knowing the proportions of the material passing the ten, the material retained on the ten, and the amount of the bitumen, we can figure from that the percentage of voids that are in the mineral aggregate should the bitumen be washed out, and that gives the actual condition which occurs on the street. What he has described is how he determined the proportion of voids in this pavement, laid under the Averell patent. The percentage of voids found was 14.8. [994—439]

Q. Now, from your knowledge of the samples of the Oskar Huber pavement which has been offered in evidence and your experience in analyzing and testing pavements, and your analysis of this pavement laid under the Averell patent, will you tell the Court whether or not this pavement laid under the Averell patent has the characteristics, so far as the degree of voids is concerned, and stability is concerned, that you find in the patent 727,505? A. I would say it has.

Q. From your knowledge of pavements like the Oskar Huber pavement, can you tell the Court whether or not this pavement laid under the Averell patent would have the wearing qualities and stability of the Oskar Huber pavement?

A. I think it would.

(Testimony of Kenneth S. Hall.)

Mr. Hall subjected this sample to a screen test. The Averell patent was issued in 1884. Mr. Hall gave the screen test of the cut as follows:

Retained on the ¼ inch.....55.8%
Passing the ¼ inch and retained on the 200 mesh 37.7%
Passing the 200 mesh screen..... 6.5%
Bitumen 6.3%

The above is reduced to the three groups described in patent 727,505. This pavement was laid May 2d of this year.

Said specimen so identified by the witness as having been laid from description contained in said Averell patent, was offered and received in evidence, and marked Defendant's Exhibit "A–32." [995—440]

Mr. Hall recombined the sizes in accordance with the proportions set forth in the Decree of the Court in the Topeka case, Defendant's Exhibit "P." He made a void test on it. The void test was 20.8 per cent. Mr. Hall has made an analysis of natural run sand bank materials, found in the State of Oregon. He made analyses on seven bank run materials, that is bank run sand and gravel. One came from the City Park in LaGrande, Oregon; one from the cemetery pit near Albany, Oregon; one from Pritchard Creek, Baker County, Oregon; two from the Santiam River, near Jefferson; one from the pit near Corvallis, and one from the Sixes River, in Curry County, Oregon. The analyses

showed with reference to the groups shown in patent 727,505 as follows:

LaGrande Sample:

Retained on the ¼ inch screen.....50.6%
Passing the ¼ inch and retained on the 200 mesh 49.0%
Passing the 200 mesh screen..... .4%
Voids 19.3%

Cemetery Pit Sample:

Retained on the ¼ inch 59.5%
Passing the ¼ inch and retained on the 200 mesh 39.8%
Passing the 200 mesh screen 7%
Voids 15.2%

Pritchard Creek, Baker County, Ore. Sample:

Retained on the ¼ inch 56.0%
Passing the ¼ inch and retained on the 200 mesh 43.1%
Passing the 200 mesh screen 9%
Voids 19.6%

1st Santiam River sample—taken about half mile below city of Jefferson:

Retained on the ¼ inch.....56.5%
Passing the ¼ inch and retained on the 200 mesh 43.0%
Passing the 200 mesh screen..... .5%
Voids 19.7%

[996—441]

(Testimony of Kenneth S. Hall.)

2d Santiam River sample—taken about a mile further downstream:

Retained on the ¼ inch	60.3%
Passing the ¼ inch and retained on the 200 mesh	38.9%
Passing the 200 mesh screen	.8%
Voids	18.9%

Corvallis Pit sample:

Retained on the ¼ inch	57.0%
Passing the ¼ inch and retained on the 200 mesh	42.7%
Passing the 200 mesh screen	.3%
Voids	20.0%

Sixes River Sample:

Retained on the ¼ inch	51.2%
Passing the ¼ inch and retained on the 200 mesh	47.8%
Passing the 200 mesh screen	1.0%
Voids	17.4%

So far as witness knows, these analyses were made from samples of materials as nature laid them in the ground. He took four samples up himself. He endeavored to get an average sample. In three of the pieces there was a wall standing straight up, and he just took a sample from the top of the pit right down to the bottom. He had a complete sample of that entire base. The other three samples happened to come into his laboratory, at the time he was making these other tests, and it was sent in by men in the field for use in concrete and road surface, for other work and had nothing

(Testimony of Kenneth S. Hall.)

to do with this case at all. He took these samples just as examples and run a void test on them. The results which he has stated are the ones which he has given. Hall has made tests of sand in combination with one size rock for the purpose of determining the voids. He took practically a one size [997—442] rock, a two-inch rock, and by adding any sand to it you can get—that is, filling the voids in the one size rock with practically any sand you can get less than 21 per cent voids. In one case he tried this test and got 17 per cent voids. Mr. Hall stated he took the Official Bulletin No. 32, published by the Canadian Government, Department of Mines, showing the road materials on the St. Lawrence river from the Quebec boundary line to Cardinal, Ontario. There were thirty different samples set forth in that report; thirty samples of pit run materials. Mr. Hall produces a sheet of paper on which he had tabulated his results from a study of those pit run materials. In this tabulation in the book there was given a detailed screen analysis, and also the percentage of voids, that were found on these different materials. He has taken the screen analysis and grouped them into groups that were compatible with the groups in the patent in suit. There are ten that have voids less than twenty-one per cent and twenty-two samples that have over 21 per cent voids—there were thirty-two samples in all. He has taken the average of all the samples, an average of the screen analyses, and he has taken the average of the screen

(Testimony of Kenneth S. Hall.)

analyses of those having greater than 21 per cent voids, and the average of the screen analyses of those having less than 21 per cent voids, and these averages are as follows: [998—443]

Average of the whole 32 samples:

Retained on the ¼ inch..... 64.3%
Passing the ¼ inch and retained on the 200 mesh 34.1%
Passing the 200 mesh screen 1.6%

Average of those samples having greater than 21% Voids:

Retained on the ¼ inch..... 64.7%
Passing the ¼ inch and retained on the 200 mesh 33.3%
Passing the 200 mesh screen 1.9%

Average of those samples, having less than 21% Voids:

Retained on the ¼ inch 63.4%
Passing the ¼ inch and retained on the 200 mesh 35.7%
Passing the 200 mesh screen ..... .85%

The average results of those three classes gives us practically the same grading and within the limits of Warren's claims in his patents and there is very little difference in the grading whether it is under or over 21 per cent voids.

The largest size of the material he found in those samples that he took by making a cut from the top of the bank to the bottom was three inches. The material he found was from three inches to that which he has described into evidence. The

(Testimony of Kenneth S. Hall.)

banks from where he took it would vary from six to ten feet. He had a pick. He cleaned off the base of the wall, first—that is, the face of the deposit, cleaned off at the bottom, and then took a pick and picked down right on a straight line, right straight through, and then shoveled what he got into a sack. He made no selection or segregation of the materials; the idea was to get an absolute representative sample of the run of the bank. He did that. Referring to the samples laid up at Rowena, the materials and the bitumen were all laid together in a [999—444] homogeneous mass. It was then placed on the road just as they do in their regular work, and rolled. Mr. Dulin assisted Mr. Hall in all those four samples offered in evidence; the Averell patent, the Pace case, the Evans case, and the 1901. They laid those pavements, as close as was possible with the working conditions there, in compliance with those several patents and those specifications in the two cases mentioned. It would be very difficult to lay a pavement to comply absolutely with the 1901 patent on account of the variations one way or the other. The difficulty, chiefly, would be because the specifications of the 1901 patent have no limits, they have prescribed certain amounts for each screen size. The difficulty would be in getting absolutely the amounts set down; that is to have an absolute stated amount. There is more leeway in ordinary specifications than you have in the 1901 patent. That is there is a maximum and

(Testimony of Kenneth S. Hall.)

a minimum that you ordinarily draw in the ordinary working specifications while in the 1901 patent the limits are not as elastic. Screens are in common use through which materials, in compliance with the 1901 patent, could be run except as to the sizes of the sand. The 1901 patent is not as economical a patent to lay as the others. It would not fit all conditions of course; not nearly as well. A pavement could be laid economically under the 1901 patent under certain conditions. The condition would depend on how your rock and material happened to be crushed or how you happen to grade them. You would have to group and grade them in [1000—445] conformity with the patent. When the grading in conformity with the patent was secured there would be no difficulty in turning out the mix for the pavement. You might have a little trouble on the street work but you would not have any trouble in getting a mixture for it. The trouble on the street is that the surface voids on the pavement would not close up. They could be closed by sprinkling sand and small chips and liquid asphalt over the top. A practical method of closing up the surface spaces would be to take a fine mixture of some kind to spread over the surface and fill up the surface voids and seal the pavement. The pavement laid under patent 727,505 is flush coated and sprinkled with screenings on top. It serves the same purpose. The road laid under 1901 patent would make a dense pavement. The bitumen would give it any elasticity that might

(Testimony of Kenneth S. Hall.)

be found in the pavement laid under the patent in suit. It would give it the resiliency of the patent in suit. He thinks the pavement would stand up just as well as the majority of pavements. No doubt about it. Witness examined pavements referred to by George Warren laid on the streets of Portland and in practically none of the heavy traffic pavements do you get the seasoned mosaic effect that Mr. Schutte speaks of, and in some of these pavements without a doubt there will be found as much as an inch of practically sheet asphalt top over the old original pavement. In some cases this top has been built up by flush coating and in the majority of cases witness believes it has come from the [1001—446] pavement bleeding in hot weather. That is, the asphalt comes to the top and it is necessary to sand that to keep it from sticking on the wheels of the tires, and the constant sanding of the pavement will build up a fine mixture on the top. The present condition of the streets referred to by Mr. Warren would indicate that on the majority of the streets they are a sheet asphalt rather than a bitulithic pavement in that there is a fine mix on top and it is no more noticeable than on a hot day such as yesterday. It is safe to say that anyone driving over the Columbia River Highway, in Multnomah County at least, who is not familiar with the pavement would consider it a sheet asphalt or at least a fine mixture pavement. Witness does not believe you can see any rock on the surface. This

(Testimony of Kenneth S. Hall.)

is caused either by flush coating it occasionally or, as is more often the case, by the pavement bleeding in hot weather and the surface asphalt being soaked up by the addition of sand or screenings or something of that sort. That condition acts as a water seal against the weather and without a doubt has a great deal of cushioning effect, which saves the rock from being broken up under traffic, such as horses' hoofs or wheel traffic. In pavements laid under specifications similar to those involved in this suit there is a movement of the rock to a certain extent as the traffic runs over it and the more mortar or bitumen you have in it the more pronounced the movement would be. It is called in engineering parlance a kneading of the pavement or internal displacement. Bitulithic pavements do not always remain smooth on the top. Conditions vary. Some [1002—447] pavements are in very good shape and other pavements are not. There are a great many causes for this but it is pretty hard in each case to exactly analyze it and state. Witness has several times placed together a combination of materials from dust to rock, such as shown in the specifications in suit. Has mixed them until the larger and finer pieces and dust were all intermingled. He has not exhibited a sample of that.

Q. Will you tell the Court if you take the mineral aggregate unmixed with bitumen, which passes the screens mentioned in the specifications of the patent in suit, whether that material has

(Testimony of Kenneth S. Hall.)

inherent stability in itself, as distinguished,—without any bitumen in it?

A. I don't know what you mean by inherent stability? Everything has inherent stability.

Q. What is the fact as to whether such a proportion of mineral aggregate without the bitumen in it will resist displacement?

A. It will resist displacement to a small extent. It is entirely comparative.

It also makes a great difference, the thickness of the layer in which your material is combined. A layer of the aggregate in the specifications in the contract in suit two inches thick without the bitumen in it laid upon a concrete base will not resist displacement to the ordinary traffic going over it without a binder. The binder no doubt adds a great deal to its stability and also holds the particles together. Witness does not think the stability of any aggregate can be dependent entirely upon the interlocking of particles. That is absurd. There would be enough stability in point of the cementing medium used on the proportions of aggregate such as involved in the contract in this suit to act as a wearing surface and resist the wear of the traffic without displacement.

(Deposition of Hall temporarily suspended.)

[1003—448]

Testimony of Charles A. Mullen, for Defendant.

CHARLES A. MULLEN was thereupon produced as a witness on behalf of the defendants herein, and, having been sworn, testified as follows:

Direct Examination.

Charles A. Mullen testified that he was born December 29, 1883, at Chapel Point, Charles County, State of Maryland, that he was consulting paving engineer, Director of Paving Department of the Milton-Hersey Company, Limited, consulting engineers and chemists, with offices and laboratories at Montreal and Winnipeg. His early education was at a country schoolhouse in Southern Maryland, public schools of New York City; academic, at Fordham University, and later, after he was working two years, at Fordham University Law School. He has been acquainted with the paving business ever since he was old enough to know anything. His father was the superintendent for the Barber Asphalt Paving Company most of his life at New York City, but prior to that in Washington, Buffalo, and a number of other cities, and, at one time, London, England for about two years. In his early years witness went around and worked with his father quite often and later on, when he was fourteen or fifteen years old, during vacations he worked at the different occupations, such as time-keeper, assistant foreman, and other minor occupations. Later on his father put him in the office to do more or less what might be termed

(Testimony of Charles A. Mullen.)

confidential office work. Still later he became a sort of an assistant to his father, handling estimates, bids, going around the work, and doing practically everything which his father did under his directions, as his work was so [1004—449] extensive that he could not possibly cover it all. That was in New York City, and embraced the district for around New York City maybe a hundred miles or more in different directions—not all directions. In 1907 witness was sent to Pittsburgh by the Barber Asphalt Paving Company, and went at his father's request, because of an emergency and took the place of a superintendent who was in a hospital, and finished up the season's work. After that witness left the Barber Asphalt Paving Company, and during the next two and a half years, 1908, 1909 and part of 1910, he was a paving contractor in New York City, doing small paving work, principally of the block type—in fact he thinks all of it was of the asphalt block, granite rock, and that type of work—still living with his father and familiar with his work. In 1910, late in the spring, he went to the City of Milwaukee as a paving expert, because they wanted certain information which they apparently could not get. He was urged to do so by parties in New York. At first he had not expected to stay, but because of developments he found that he practically had to remain there and became superintendent of street construction and repair. He was then twenty-six years old. He was twenty-four when he took the place of the

(Testimony of Charles A. Mullen.)

superintendent of the Barber Company in Pittsburgh. He remained in Milwaukee until about December 31, 1911, and went from there to Schenectady, New York, to become Commissioner of Public Works. He was then twenty-eight years old. He served the full term of two years as Commissioner of Public Works, and then returned to New York [1005—450] and went into the contracting business with Michael J. Leshy, an old contractor, and did a certain amount of contract work there. It was while he was still with Mr. Leshy, though there was not much contracting work at that time, that witness was sought for by the Milton-Hersey Company to do special work in connection with bituminous paving in Montreal, sheet asphalt, principally. Witness had not heard of them nor applied to them in any way. They had learned of him through independent sources, but he went there with them under a six months' agreement to straighten out the city paving plant as regards the bituminous paving mixture. He joined the company around July, 1916. He has been with them ever since. During the six months' original period they offered to establish a definite street paving department and give witness the complete direction if he would stay. Ever since he has been there he has had charge of the work, and it is now a large department. They have clients from the towns just across the river, from Detroit, Waterville, Kingsville—as far east as Charlottetown, Prince Edward Island—which is about as far as one can travel

(Testimony of Charles A. Mullen.)

in thirty-six hours, going east, either way. Under witness is a consulting engineer, who takes charge of the tests; they work together, although witness is senior in authority; and under the engineer there is the laboratory, which is part of a very large laboratory that handles all sorts of testing work for industrial firms and railroads. One of their largest lines of business is that they are chemists for the Canadian Pacific Railway and the Grand Trunk and Grand [1006—451] Trunk Pacific, and a number of others. Practically all of the railroads in Canada come to them for work, and some in the United States retain some of the members of the firm. In the case now pending in which Warren Brothers Company is complainant and city of Montreal defendant, about two years ago a complaint was filed charging infringement, and witness wrote an original report to the city. They employed a patent attorney and turned it over to him. He has since been working on that case for Mr. Russell S. Smart, one of the patent attorneys for the city of Montreal. In 1917 witness published a pamphlet book of about one hundred pages, entitled "Paving Economy." Witness is acquainted with the paving which the Warren Brothers call bitulithic or Warrenite or asphaltic concrete; with the sheet asphalt pavement; with the Topeka mix; there are any number of other asphaltic mixtures. There is the regular asphalt, which is the very finest material, as far as he has been able to use, for paving purposes, known as

(Testimony of Charles A. Mullen.)

sheet asphalt; then what might be termed the grit mixture; then we get a little higher with the Topeka mixture, and finally up until we have what is called by the plaintiffs their bitulithic. He did not receive in his business this report from the city of Hamilton which was written by Mr. Heddle. He has a copy of that report, of the parts of it that pertained to pavement. He got that at least a year ago. Can establish the exact date by correspondence. Since the matter came up in Montreal he has been through the files of the Patent Office and selected different patents; been through a lot of the records of the Engineering Society in New York [1007—452] and gotten all the literature he could on the subject, and have gone over it as carefully as time has permitted. He has not had time to finally summarize everything—he was called into this case so suddenly that it was impossible to get all those facts together so as to have everything practically indexed. Witness has visited Omaha, Nebraska, only once, and that was on the way to Portland this trip. Mr. Mullen received a sample of some Omaha pavement sent by Mr. Beal, about a year ago. Witness had an analysis made of that sample in his laboratory, has the analysis with him. Hasn't the sample with him.

Mr. LYMAN.—Well, how is that material unless we see the sample? Is the sample here? Have you got the sample?

The COURT.—No.

A. No.

Mr. LILJEQVIST.—I don't think it is necessary;

(Testimony of Charles A. Mullen.)

Mr. Beal testified that he sent Mr. Mullen a sample from that identical pavement.

The COURT.—I know he did.

Mr. LILJEQVIST.—Is it necessary in a case of that kind to bring into court the sample?

Mr. LYMAN.—Well, let it go ahead, your Honor.

The COURT.—It is very uncertain testimony.

Mr. LILJEQVIST.—Have you an analysis of that sample?

A. I have.

Q. Will you give it?

A. I will have to get it from my papers there. Will you excuse me?

The COURT.—Yes.

(The witness thereupon left the witness-stand and returned with some papers.)

Witness received from Mr. Beal by express two samples of pavement, one sample they marked "O–1" and the other sample was marked "O–2." He sawed these samples on a marble bed, marble saw and numbered the parts "A" and "B." This analysis is of O–1–B, as follows:

Bitumen	3.6%
Passing 200 mesh	5.6%
Passing 100 mesh	2.2%
Passing 48 mesh	2.9%
Passing 28 mesh	6.6%
Passing 14 mesh	6.6%
Passing 8 mesh	2.7%
Passing 4 mesh	5.3%
Passing ⅜ mesh	7.9%

(Testimony of Charles A. Mullen.)

Passing ¾ mesh.....24.6%
Passing 1½ mesh.....32%
Over 1½ inch .....None

Subdivided this gives following percentages:

Impalpable powder (passing 200 mesh sieve). 5.6%
Passing 4 mesh and retained on 200 mesh sieve 26.3%
Passing 1½ mesh and retained on 4 mesh sieve 64.5%

The four mesh sieve is about a fifth of an inch, and three mesh sieve is about a quarter of an inch in diameter. There's some confusion about what the patent in litigation means by saying one quarter inch in diameter. Mr. Schutte, in [1008—453] his analysis submitted, used the four mesh sieve, and we have in a great many cases done likewise, but there is not so much difference in most cases as to make any particular difference. For instance, if the entire other size, which would include the three mesh, that is, the material passing the three-eighths and held on the four mesh, were included in the middle aggregate, it would only add 7.9 per cent more to that. A three mesh more nearly approximates one-quarter inch in diameter than the four mesh, because of the thickness of the wires. Witness means three meshes to the inch. A four mesh has four wires to the inch, and the thickness of those wires is deducted from the actual aperture. A quarter inch sieve is spoken of indifferently as a four mesh sieve or an aperture one-quarter inch. There is a good deal of ambiguity in the general

(Testimony of Charles A. Mullen.)

trade about that. Including the size of the wire, a mesh that has four wires to the inch—three not counting the first one—would have apertures of approximately a quarter of an inch. Witness has a scale that shows the actual diameter of every sieve. Witness exhibits a paper to the Court, stating that it is drawn up in accordance with the Tyler screen scale, standard screen scale and the distance between the wires, that is, from edge of the wire to edge of the wire, on a three mesh, is .263 of an inch, which more closely approximates a quarter of an inch than the space between the wires of a four mesh, which is .185 of an inch, straight across. It isn't taken diagonally, it is square. It isn't diagonal. It is referred to as a diagonal and you will find it in the standard screen catalogs as such. Now, in this part there is a logical progression between these linings a half inch apart. Each one shows an opening 1.414 of the one [1009—454] preceding, and thereafter the ratio in any section on that is equivalent to the ratio in any other section. Now, we have been talking about the ten, twenty, thirty, forty, fifty, eighty and one hundred mesh sieves and two hundred mesh sieves. They are illogical in range, and you will note that by seeing that the distance between one hundred, the ten and the twenty is two full spaces, between the twenty and the thirty is a space and a half, the thirty and forty about equivalent to one space—those dotted lines are what is known as the old asphalt scale—the forty and fifty is about the same, and then you will see there

(Testimony of Charles A. Mullen.)

is quite a jump from the fifty to the eighty—it is not an equivalent space in there—and from the eighty to the two hundred is a very big jump. It is an old illogical screen scale. Now, the chart is made on one which is a logical progression and is explained in Tyler's catalog. Tyler is one of the few prominent manufacturers making screen scales, and witness has that catalog and it will help in the explanation of that chart. The sample marked O–1–B of the Omaha pavement sent to witness by Mr. Beal contained slag; 12.5 per cent of voids. Has no record of the cementing material used in that pavement; it was bituminous. In that sample they noted a very low bitumen content; it was 3.6. The analysis of the other sample marked "O–2–A," is as follows:

Passing 200 mesh	4.9%
Passing 100 mesh	6.4%
Passing 48 mesh	20.0%
Passing 28 mesh	16.0%
Passing 14 mesh	10.2%
Passing 8 mesh	4.4%
Passing 4 mesh	8.1%
Passing ⅜ inch	21.0%
Passing ¾ inch	9.0%
Over the ¾ inch	None.

[1010—455]

Subdivided this gives following percentages:

Impalpable powder (passing 200 mesh sieve)	4.9%
Passing 4 mesh and retained on 200 mesh sieve	65.1%
Passing ¾ inch and held on the 4 mesh	30.0%

(Testimony of Charles A. Mullen.)

That is subdividing it according to the range of the grading in the patent, as near as possible. The patent does not definitely say that the two hundred mesh sieve is the measure of impalpable dust, but it does not definitely say what mesh constitutes the one-quarter inch in diameter. The lowest voids witness got on that sample was 18.8%; the highest was 21.7%. Witness hasn't the bitumen content on that sample. On these Omaha samples there was a thin surface ranging from half an inch to three-quarters of an inch. He could identify the samples with those that he saw in Omaha when he was taken around with Mr. Beal; they were exactly like that as far as witness can tell. This analysis was made excluding the top surface. Witness has been in Hamilton, Canada. The streets that Mr. Heddle has testified to cannot be examined; they had either been resurfaced or were buried under the present pavements. As far as witness knows, they have all been resurfaced. Witness did not cut through them; he had Mr. Heddle try to get samples for him but he failed to do so for the reason that the tar had hardened so that the samples dropped apart. Mr. Heddle finally did send witness one sample just before he left that shattered as soon as he opened the box but it had been together and keyed in so that he solidly shipped it. Witness had no way of making an analysis of that piece. Witness has been in Washington and examined the pavements there. The sample from Vermont Avenue is submitted there. The sample in exhibit is the sample taken

(Testimony of Charles A. Mullen.)

by witness. Taken [1011—456] from Vermont Avenue, Washington, D. C., between H and I Streets. Witness has the descriptive matter, the memorandum that he took at the time, showing the exact location where he got the sample. Witness took two samples from Vermont Avenue in Washington. Sample No. 1 was taken by witness, with the assistance of laborers furnished by the Highways Department of the District of Columbia, two negroes, on Tuesday morning, July 27, 1920, between nine and ten o'clock, from the easterly side of Vermont Avenue, between H and I Streets Northwest, Washington, D. C., at a point thirteen short paces, about twenty-six feet, or about one-third way across the roadway from the easterly curve. The southerly side of the cut made to take this sample was about centered on the entrance of the store of S. Robinson & Brother, Tailors, house No. 809 Vermont Avenue; and the northerly side of the cut was about centered on the northerly side of the southerly door of the main entrance of the War Risks Building. This sample was, roughly estimated, about 18 inches by 24 inches in surface area, and about 8 inches thickness, all the way through. The sample brought into court by witness is a part of that sample. Mr. Beall, of the Highways Department of Washington, D. C., went there with witness. They endeavored to select locations where there was every evidence that the original wearing surface had been undisturbed, that is, the wearing surface laid in 1880, and they both agreed

(Testimony of Charles A. Mullen.)

that at the point where the sample was taken there had been no subsurface work or repairs on it. The street is rather easy to tell where it has or has not been repaired. Witness [1012—457] has been over that street ever since he can remember. It is one of the most noted sheet asphalt wearing surfaces in the industry. That relates to the top two inch wearing surface of the fine texture, which the records show was laid in 1880. The concrete base underneath was laid in 1870.

Said specimen of pavement from Vermont Avenue, so identified by the witness Mullen, was thereupon offered and received in evidence and marked Defendant's Exhibit "A–34."

Mr. LILJEQVIST.—(In statement to the Court.) I want to show, from the standpoint of identification, Mr. Hall's, who also took from Vermont Street, which is already in evidence, so that the Court can see for himself whether Mr. Hall's testimony connects up with the deposition of Mr. Beall, which is already in the record.

Witness asks counsel to turn the sample flat on its bottom. Calls attention to this fine texture surface which extends about two inches from the wearing surface, which is now at the bottom, then a finer mixture averaging possibly one inch, but being irregular in its bottom contour, and base of large red stone. Mr. Mullen analyzed both the fine upper wearing surface or sheet asphalt top, and the intermediate asphaltic concrete mixture between that and the large stone base of red stone, of that sample.

(Testimony of Charles A. Mullen.)

The analysis of the intermediate layer of asphaltic concrete below the sheet asphalt top, and between it and the red rock base, is as follows: [1013—458]

Passing 200 mesh..... 4.4%
Passing 100 mesh..... 3.3%
Passing 48 mesh..... 6.5%
Passing 28 mesh..... 6.9%
Passing 14 mesh.....10.2%
Passing 8 mesh..... 8.2%
Passing 4 mesh.....13.3%
Passing ⅜ inch.....16.2%
Passing ¾ inch.....19.6%
Passing 1½ inch.....11.4%

Subdivided this gives following percentages:

Impalpable powder (passing 200 mesh sieve). 4.4%
Passing 4 mesh and retained on 200 mesh sieve 48.4%
Passing 1½ inch and retained on 4 mesh sieve 47.2%

Witness did not make this analysis with particular mesh screens for the purpose of the Canadian suit. The subdivision is not mentioned in the patent at all. In their regular laboratory practice, with coarse aggregates, they, too, use the standard asphalt screen, with logical sequence, instead of the old sheet asphalt set, which is not. The two screen scales can be compared. Witness took a sample from Pennsylvania Avenue. Also took a sample from DeSales Street personally in January, 1917. The samples taken by witness from those two streets

(Testimony of Charles A. Mullen.)

looked the same as the samples taken by Mr. Hall from those same streets.

Mr. LYMAN.—I object to that characterization, if your Honor please. Let's see them.

Witness hasn't those samples with him. He hasn't a photograph of the DeSales Street sample. They just have a sample that they have carried in the laboratory as a curiosity since 1917. Witness produces a book of true photographs of the samples of pavement he took in Washington—of Vermont Avenue, Massachusetts Avenue and Pennsylvania Avenue. Witness saw the photographs made; they were made in his laboratory by his own men. Witness took the samples at the places designated by Mr. Beall. The photographs are true photographs of those samples.

Said book of photographs was offered and received in evidence and marked Defendant's Exhibit "A–35."

Mr. LYMAN.—Well, I object to it as not the best evidence. The samples ought to be produced if they are relied upon. [1014—459]

Mr. Mullen is familiar with sheet asphalt pavements. As to whether sheet asphalt pavements had graded sand in them prior to the year 1900, his first information on that point came from his father. He was in the habit of examining the sand, any sand that he might see in a pile anywhere, picking it up and looking at it carefully, sometimes under what is known as a linen glass, and he always explained the necessity of having sand graded from fine to coarse.

(Testimony of Charles A. Mullen.)

His term was not to fill the voids; he usually said it was to make it packy; he told his son that Professor DeSmedt was the man who first told him about that and pointed out to him the necessity of having graded sand and pulverized limestone. There is further evidence of that in an article written by Mr. A. D. Dow prior to 1900. There are different kinds of contractors, and some of them will use any kind of sand that they can put down on the street with a little asphalt and that will stay there long enough for them to get to the city hall and get their money. There have been a great many bad sheet asphalt pavements laid, and some contractors, will use any, but contractors that have been trying to lay a good pavement have always recognized the necessity of the grading of the sand and have usually employed two, and sometimes three, different sands from different sources, having different characteristics, to get approximately a definite grading. Witness has analyzed the top of this Washington sample which was laid in 1880.

Adjournment.

May 31, 1922.

Testimony of CHARLES A. MULLEN resumed.

The analysis is as follows: [1015—460]

Passing 200-mesh	19.6%
Passing 100-mesh	5.2%
Passing 80-mesh	2.7%
Passing 50-mesh	20.6%
Passing 40-mesh	25.5%

(Testimony of Charles A. Mullen.)

Passing 30-mesh 12.9%
Passing 20-mesh 8.9%
Passing 10-mesh 3.9%
Passing 4-mesh 7%
Totaling 100 per cent.

Witness produces a logarithm graph on which the analysis given is plotted over 10-mesh, to 10 to 200-mesh. The grading runs far beyond the 200-mesh, we know by sieve analysis—no, every analysis that was made had the grading sheets on, the material is graded down to considerably below one ten-thousandths of an inch, and from the material that he has examined under the microscope as indicated, that it probably runs down to one-hundred thousandths of an inch. Now, the moving of that graph to the right or left is similar to the application of the multiplication table or the division table or to the use of a magnifying glass. There is no change in the relation of the sizes of the grains to each other; the mixture remains the same except as it is enlarged. It is enlarged there 45.3 times at the last line; in other words, the mixture represented by the line running up to the 3 per cent held on the 2-mesh is forty—magnified 45.3 times, the first time to the left. In other words, the magnifying glass or the multiplication table has been used.

Thereupon the graph was offered and received in evidence and marked Defendant's Exhibit "A–42."

Witness has the sieve analysis which is the result of still applying the multiplication table, mag-

(Testimony of Charles A. Mullen.)

nified, of the sheet asphalt mix. In this analysis, it is not [1016—461] possible to use the same sieve numbers because of the difference in the old asphalt scale and the standard scale of which witness has spoken. The old asphalt scale is not susceptible to treatment on a chart of this kind. The old asphalt scale has been used up to the present time for sheet asphalt, but when you get into coarser aggregates such as concrete or bituminous concrete, then the standard scale is more used. In 1902 and '03 the old asphalt scale was in date, but the necessity—in order to obtain this scale, is that we are now getting up into the higher sizes.

Q. (By Mr. LILJEQVIST.) You mean the change in the screen, the change in the screen scale or change in the weighing scale?

A. No, it is the change in the scale, it still shows the mixture. The same mixture can be charted and shown practically on both scales as we have done on these charts, and such things are regularly done.

Q. Now, state to the Court what your sheet asphalt mixture enlarged by the chart shows from the standard of the Warren patents?

A. I have here two analyses, one marked B, being the sieve analysis of the sheet asphalt as taken, and one marked A.

The one marked B is the same as witness gave a moment ago. The one marked "A" is an enlargement of same so as to correspond to the furthest line to the right on this graph. The first one is read on the last curve to the left, the last one, "A,"

(Testimony of Charles A. Mullen.)

and the last curve to the right when taken off there, they show approximately the same grading of material. [1017—462]

Said sieve analysis marked "B" was offered and received in evidence and marked Defendant's Exhibit "A–37"; and sieve analysis marked "A" was offered and received in evidence and marked Defendant's Exhibit "A–38."

An examination of the sheet asphalt pavement laid in Washington in 1880, simply enlarged, shows that the present type of asphaltic concrete would or would not infringe the patent, depending on how it is laid, but which is similar to pavements laid by the plaintiff, it shows such a pavement; but so as to have no misunderstanding, the material which is enlarged to four mesh is practically that which under 200—200 mesh in the sheet asphalt. Therefore, there is no grading for that, so the way it has been done in this analysis "A" is to take the grading of the sheet asphalt and reduce it 21 per cent; everything going through the 200 mesh has been so reduced as to be 21 per cent in the material going through the 4 mesh, including the 200.

Q. Enlarging this sheet asphalt as laid I wish you would analyze and place upon a graph and reducing it to the proportions in the patent, what does it show with respect to the proportion retained approximately on the quarter-inch screen, passing the quarter-inch screen and retained on a 200 mesh screen and that passing the 200 mesh screen?

A. You said a quarter-inch? It will mean a quarter-inch in diameter or three-mesh, would be

(Testimony of Charles A. Mullen.)

different from a quarter-mesh, but it is divided on a four mesh, and between the 4 mesh and the 200 mesh there is 16.9 per cent. Between [1018—463] the 3 mesh and the 200 mesh there is 20.9 per cent. Above the—between the 3 mesh—no, between the three-inch and the 3 mesh there is 75 per cent. Between the 3 inch and the 4 mesh there is 79 per cent. Passing the 200 is 4.1 per cent. That is all now for the record. Now, there is a point in there which I would like to explain. If this were aggregate submitted for making an asphaltic concrete pavement, one might screen out the material held between the 3 and 1½ inch, there is 4.6 per cent, or you might even screen out the material between the three inch and the one inch, making a total of 10 per cent. That would be necessary if this were intended for laying 2 inches thick, because the stone becomes almost that thickness; and in the case of the 3 inch stone, it is more than the thickness; but in the sheet asphalt where the thickness of the maximum grain that is used in a large quantity, the diameter of this maximum grain is very much less than the thickness of the wearing surface. In view of these sizes it is not made in any different, and it is not customary to put them in the analyses. Mr. Mullen's laboratory has made one analysis of the sample of gravel and sand which they secured from the river Sarnia, Ontario. They have gotten reports from the Canada Department of Mines covering all of the aggregate on the top that way, that is, the coarse aggregate, sand and gravel, and have examined them

(Testimony of Charles A. Mullen.)

and made charts of them to compare them with the claims made in this patent. Mr. Mullen was handed Bulletin 32, an official publication of the Bureau of Mines of the Dominion of Canada, on [1019—464] page 14 of which is a mechanical analysis of gravel. The analysis was made by the Canada Department of Mines and reported in official publication. There are 33 samples, 13 of which do and 20 of which do not infringe the Warren claim.

The COURT.—(Interrupting.) What do you mean his claim—the certain deposit in the mountains up there in Canada infringed any claim?

A. It is given to find and you will find most sands and gravels arranged in natural deposits.

The COURT.—Who is liable for that infringement?

Mr. LILJEQVIST.—Well, what I want to show is that nature itself has made—

The COURT.—(Interrupting.) Well, nature is not on trial here.

Mr. LILJEQVIST.—We are trying to show that nature—

The COURT.—(Interrupting.) I don't see how it infringes Warren's patent.

The WITNESS.—Well, if made into a paving mixture it would infringe.

Thirteen samples had less than 21% voids; 20 had more. Five of the thirteen samples showing less than 21% of voids also fall within the grading of Warren's claim three literally interpreted so that it does not extend beyond or below the grading of

(Testimony of Charles A. Mullen.)

any one point. Witness stated it is possible to take claim 3 of the Warren patent 727,505 and arrange it in a pavement and have over 21 per cent of voids in all. Mullen was asked whether he had combined materials that would remain on a quarter-inch screen, materials that would pass a quarter-inch screen and remain on the 200 mesh, and materials that would pass the 200 mesh, in the proportion of 50 to 80, 10 to 49 and 1 to 3 or within those proportions to determine whether more than 21% of voids would be obtained, and Mullen produced certain jars and stated the purpose of these jars to show the many different gradings which may be made within Warren's claim 3 of the United States patent. Jar number 1–A contains of the coarse material passing two and a half inch and held on a two-inch sieve 80%, which is the maximum of the claim. It is uniform sized material, but it is all held on the one quarter inch or four mesh screen. Between the four mesh and the eight mesh there is 17% and from the 200 mesh down there is 3%, making a total of 20% falling within that claim literally interpreted, and it makes a mixture that is [1020—465] very well illustrated in the jar. The voids in the mixture are about 35% and that combination would come within claim 3. Jar 3–A contains of the coarse material 50% which passes two and a half and is held on the two inch sieve, that is the middle; it contains 47% passing the four and held on the eight mesh, that is very closely ap-

(Testimony of Charles A. Mullen.)

proximating the maximum of that grade. It contains three per cent or the maximum material passing the 200-mesh sieve and 26.9 per cent of voids. That is using the lower limit there. The first jar used the upper limit for the coarse material, the second one the lower uniform sized material for that one grade. Just what succeeding grades has got to be shown; that was taken as defining what it didn't mean. Jar 2–A is a well graded mixture within these claims, that is it is graded from coarse to fine within each claim and it is graded to get a low per cent of voids. It is of the coarser material through the two inch and graded down to the four mesh. Passing the two inch and graded down to the four mesh 71.4 per cent of the material; passing four mesh and graded down to the 200 mesh 26.5%; material passing the 200 mesh 2.1 per cent. The voids are 12.9%. Jar 1–B contains as a coarse material 80 per cent that will pass through the three eighth inch and be held on the 4 mesh; seventeen per cent that will pass the 4 mesh and be held on the 8 mesh; and 3 per cent passing the 200 mesh, 100 per cent all, and the voids are 35.8. Jar 2–B shows 57.8 per cent passing the 3/8 and held on the 4 mesh. That is rather uniform sized material; it is 39.2 passing the 4 mesh and graded down to the 200 mesh. It has 3 per cent passing the 200 mesh, making a total of 100 per cent, and has 15.4 per cent of voids. Jar 3–B contains [1021—466] 50 per cent of material passing the three eighth inch and held on the 4 mesh;

(Testimony of Charles A. Mullen.)

47 per cent passing the 4 mesh and held on the 8 mesh; and 3 per cent passing the 200 mesh, down, making a hundred per cent, and has 35.4 per cent of voids. Those are the only jars witness has prepared and they were prepared to show the extremes of this claim as an illustration of that point, and one or two of them to illustrate what another claim would indicate. Mullen was asked if he didn't know anything about paving or making mixtures and he took mineral aggregate within the proportion shown in that claim and put them together in a pavement if he could get the diverse result that he has shown to the Court and he stated the extreme would be unlikely to be reached in any materials ordinarily purchasable there by us, but one might get very diverse results under the limits of that claim having either below, or few below, or considerably above 21 per cent of voids. There is nothing in claim 3 to indicate how he would go about getting results contained in those jars. If witness put the materials together as containing the percentage of rock that he has testified to, he would arrive at the results testified to, but he doesn't think any one would go to those extremes; but many instances could be made which would approximate those under that. Claim 3 is so broad that if you tried to use his entire limit in all cases, you are up against a physical impossibility. It reads 50 to 80 per cent held on 3 mesh or between 3 inch and one-quarter, ten to 49 per cent between one-quarter and 100 mesh, and 1 to 3 per cent [1022—467]

(Testimony of Charles A. Mullen.)

through the 200 mesh. To use the low limit on the middle material, even with using the very maximum limit on the other three, one is still shy 7 per cent of a hundred per cent. It can't be done; therefore, the only practical limit there is 17 per cent. The thing has been so as to go beyond physical impossibility. Witness knows the patent description itself will show so far from the maximum that on the maximum the middle material that the minimum of coarse and fine can't be used without being up against a physical impossibility. The claim is broad beyond all reason if it is to be interpreted literally. Mr. Mullen has examined claims 5, 6 and 11 of the patent. After examining claims 5, 6 and 11, with the experience witness has had in paving, he stated those claims are not definite enough to indicate how a pavement should be laid. For instance, a street pavement, a bituminous mineral structure, the mineral ingredients which are mixed and of several grades, these mixtures of stone in the jar are all mixed and of several grades, so graded as to give the structure an inherent stability. The term "inherent stability" applies to, witness thinks, practically everything, and there is no way here of measuring inherent stability in a pavement or in the aggregate. It is a matter of degree of a thing, and not so much as the thing itself; in other words, the reverse of "inherent stability" is inherent instability, and it depends largely upon the point of view of the person using the words, just words. If a pavement is subjected [1023—468] to wear for

(Testimony of Charles A. Mullen.)

a good many years and stands up under that wear, that pavement and the mineral aggregate composing it will have a very decided amount of inherent stability as due from the paving uses. There are a great many sheet asphalt pavements which have sand passing the 10 mesh standing up under heavy traffic for many years. Witness was rather surprised to learn here how bad a failure the sheet asphalt pavement was; he always thought it was the most successful pavement used, that and a small stone mixture, and he still so advises his clients, and though the patent for this coarser mixture is out in the United States and about to go out in Canada, he had not and do not intend recommending it to any client. He has made the statement, and it is a similar view that will be held by a great many others in the bituminous paving business, that if sheet asphalt were the patented pavement and asphaltic concrete the unpatented, that he would be willing to pay the royalty to lay the sheet asphalt. There are a number of striking instances in the country of sheet asphalt pavements, which had the largest mineral aggregate passing a 10-mesh sieve, standing up under wear and heavy traffic for many years. The 1880 pavement from Vermont Avenue is still there, though when it was originally laid, it was in front of the old Arlington House and was not far from the White House; it was subjected to hotel traffic. It is a wide street and gets a good deal of light traffic, not much heavy traffic. That Arlington Hotel has been torn down, disturbing

(Testimony of Charles A. Mullen.)

some of the old pavement directly in front of it, where a new curb was put in and a new grade; and the samples which he took were not from that section, and now the War Risk building [1024—469] stands there, the pavement is still in use and there is no evidence of any great amount of repairs. It is quite easily seen that a very large part of the original construction is there. Also the LaSalle Street pavement in Washington. These pavements have withstood traffic during all these years. Mullen stated claim 6 of the patent would include any pavement of a dense nature, bituminous cement, ranging from rock asphalt up to the present *course* asphaltic concrete; they all contain mineral ingredients of such grade as to give the structure an inherent stability, and they are all mixed, even the rock asphalt, using the product of mixing two native rocks. That claim doesn't show, however, under this claim. Claim 11, standing alone, would permit the use of an uniform graded stone and pulverized stone dust; in other words all of the material between the quarter-mesh and the 200 mesh could be left out and material above and below only included, and the pavement would have less than 21 per cent of voids. It doesn't indicate any particular material, standing alone, it doesn't indicate any particular construction. Witness has analyzed sand passing a ten-mesh screen; that is a regular part of the work in laying asphalt pavement. Witness stated he could range sand, in combination with impalpable powder, from a 10-mesh screen down

(Testimony of Charles A. Mullen.)

to less than 21 per cent of voids. Asked if he could take sand that will pass a ten-mesh screen down, including impalpable powder, and make pavements of a structure which have less [1025—470] than 21 per cent of voids, he stated he don't know because he has never made any tests of the aggregate after combined with the bitumen, but he has made tests of the aggregate in the cone; there with sand alone and stone dust and following quite clearly a specification published in Washington in 1879, can quite clearly get less than 21 per cent of voids; practically you can get less than 20 per cent of voids. Witness is referring to the Annual Report of the Commissioners of the District of Columbia, which he produces. The report is marked 1878. The stamp as to date of publication shows Washington Government Printing Office, 1878; it says inside, "Annual Report of the Commissioners of the District of Columbia for the year ending June 30, 1878." This report is certified by the Secretary to the Board of Commissioners of the District of Columbia. His analysis wasn't made from the report, it was made independently of the report. He ran across this report after the analysis was made, but it corresponds with the use of it. On page 289, at the top of the page, is a heading reading "Specification for laying asphaltum pavement (bids opened October 19, 1878)." Midway down the page is an item 3. Item 3 relates to a bituminous concrete of broken stone and sand laid as a foundation or blocks

(Testimony of Charles A. Mullen.)

along the street railway. This relates to the base, it is in connection with blocks along the rail, it merely indicates what was known as asphaltic concrete in those days. On page 292 is "Specifications of the process under which award was made (Bids [1026—471] opened October 19, 1878)." That is the same date given on page 289 of the specifications. In italics under that we find, "Materials, proportions, machinery, and equipment for laying asphalt pavement, commonly known as 'Grahamite,' as proposed to be done by J. S. Baldwin & Co., upon streets named in their accompanying bids." Then a new paragraph begins the ordinary printing as follows: "We propose to lay the asphalt pavement, generally 'Grahamite' invented by E. J. DeSnedt, manufacturing chemist, and laid by him on Fifth Avenue, in New York, Sixth Street in Philadelphia, Pennsylvania Avenue and F Street, Washington, and elsewhere. The following are the specifications: 1st, refined Trinidad asphalt, 2d, heavy pure petroleum oil, 3d very fine sand containing about 15 per cent morphous carbonate of lime, or 10 per cent hydro-silicate of alumina." That specifications precedes the laying of the Vermont Avenue pavement in 1880. Though it doesn't mention the contractor, witness understands, who laid the 1880 Vermont Avenue pavement. He has the annual report of the Commissioners of the District of Columbia for the year ending June 30, 1882, published at Washington Government Printing Office, 1882. This shows the

(Testimony of Charles A. Mullen.)

same asphaltic concrete along under the blocks on the car rails, and a sheet asphalt mixture. These specifications give the proportions of the asphaltic concrete better than the other did. On page 189, just a few lines at the bottom, there is a heading across the page, "Specifications for laying asphaltum pavement, [1027—472] 1881. 1—asphaltum pavements will be 2½ inches in thickness when compressed, with a base of hydraulic cement—concrete 6 inches in depth." On page 190 is the bituminous concrete foundations of blocks, and on page 191, Section 4, the following: "4. The following specifications for wearing surface will be adhered to, unless a more satisfactory pavement should be presented: The wearing surface will be composed of—first, refined Trinidad or Cuban asphaltum. 2d. Heavy petroleum oil. 3d. Fine sand, containing not more than one percentum of hydro-sicilate of alumina. 4th. Fine powder of carbonite of lime." Then at the bottom of the page a paragraph begins: "The asphaltic cement being made in the manner above described, the pavement mixture will be formed of the following materials, and in the proportions stated: asphaltic cement from 15 to 18; sand from 70 to 65; pulverized carbonate of lime 15 to 17." Besides the carbonate of lime, which would go in as such, there is similar material present in native Trinidad Lake asphalt, which is provided above as one of the two asphalts to be used, which would probably add at least three and possibly four per cent more of material passing the 200-mesh sieve; while all of the 15 to

(Testimony of Charles A. Mullen.)

17 per cent of pulverized carbonate of lime wouldn't pass. The usual standard is around 75, and in some cases it runs up as high as 85 or 90 per cent of carbonate of lime or pulverized stone dust which passes the 200-mesh sieve. Taking the specifications given there witness thinks he could make up a mineral aggregate which has less than 21 per cent of voids although it would be difficult to get that three or four per cent of the pulverized silicate out of it. [1028—473]

Asked to state the practice with reference to getting what complainant calls the layer fitting into each preceding size, Mr. Mullen stated the sand in a sheet asphalt pavement may be considered the coarse material, or at least most of it; there is little of it which runs down rather fine. The sand in a sheet asphalt would mostly classify relatively with the coarse material in a coarse asphaltic concrete of bitulithic type, that is, it would form the structure or body of the pavement, only much smaller in maximum size; the 50 to 80 per cent would be sand instead of stone. Then the stone dust would form the middle and fine; in other words, it would correspond with the material in Claim 3, which passes the one-quarter inch in diameter to 200 mesh, and also the material which is referred to there as impalpable powder to the 200 mesh. The reason those divisions cannot be made of sheet asphalt at a corresponding fineness to the maximum particles is that there are no testing sieves which go that fine, and the only way of separating that material of which I know that is satisfactory is that

(Testimony of Charles A. Mullen.)

an air separator, which I believe was invented at the Bureau of Standards at Washington, and of which we have a duplicate and which we use. The other way of examining is with a microscope. We have made such examinations and can show how fine the material runs under the 200 mesh. Pavements are made with material very considerably bunched and with material looser. In either case you get a packy mixture which relatively would fall within the general type of coarse asphaltic concrete, in which the voids of the sand grains are filled with this [1029—474] minutely fine particles, pulverized stone dust, and the parallel he thinks is quite true there. There are some factors which make it impossible, relatively, to get the same amount of small material, the same amount of relatively small material in sheet asphalt. In other words, in dealing with such very fine particles the surface tension form such resistance that it cannot be driven together in particles the size of one-inch or two-inch stone. Also, in manufacturing a sheet asphalt grading from a maximum of 10 mesh, or, say, one-tenth of an inch to a maximum of one inch for asphaltic concrete, you magnify the smallest grain corresponding, that is, 10 to 20, which means in the coarser mixer you have voids which have been so enlarged by the magnification that the materials available will now fill them; that is, there is a limit to the fine material, but no limit to the coarse material except the thickness of the pavement, or, as some people prefer, a maximum of one-half the thickness. Witness was asked to

(Testimony of Charles A. Mullen.)

state whether it is possible practically on the street to take a material which you pack into a truncated cone by hand so each size will fit into each other size to duplicate that same thing out in the street laying bitulithic, and he said the only way to do it would be to have a surface of the material passing the screen, of the 10-mesh sieve, that is, the fine material, so as to take care of the dislocation of the large particles due to spreading them out to a thickness of two inches. If one took a cross-section of a cone and could get a cross-section picture of it and draw two lines across it two inches thick, it is evidence that some of the stones would go above and below, [1030—475] and when laid those stones have to be accommodated in the mixture, they can't bind in as convenient places as in a cone. such as now used, Mr. Schutte's practical drawing. Of course, rolling and raking and all that, and the segregation in dumping has some slight effect, but the mixture can be so adjusted from the cone itself as to fill the dents when put on the street, but there is evidently not the coarser mixture, whether it be what is known as a sub-binder or the asphaltic binder or the bitulithic, a honeycomb surface when this material is raked and rolled, indicating the relocation made necessary by the two inches of thickness. There is this honeycombing which has to be taken care of with a seal coat, and if this honeycombing were not present it would indicate that there was slightly too much fine material, or at least more than the cone test would indicate. At

(Testimony of Charles A. Mullen.)

any rate, it is evidenced that the honeycomb is due to some dislocation in the mixture as opposed to the cone.

Q. In other words, then, if you pack the cone, pack it scientifically with each succeeding size of rock in such proportions that each succeeding size will fit into preceding size, are you able to duplicate that in practice; if so, to what extent?

A. That is Claim 12 and when screened closely it is another one of those physical impossibilities. The only way to so pack cones would be to do it as a masonry proposition. Now, the patent doesn't clear that up, but Mr. Warren's publications do and he there describes the filling of a cone with material of approximately one size, the dumping of it out and the putting in of the next size. That next size [1031—476] will not, by the mere accident of mixing and putting in, bind all of the voids into which it could go; there would be a certain loss the maximum possible where it is done by hand.

Q. Do you know from your experience in the paving business whether it was necessary for the Warren Brothers Company to instruct the engineers all to build a pavement so as to come within the description in the patent before they could lay it? A. Well, they never instructed me.

Q. They never instructed you?

A. I think the average city engineer, or even road engineer would need quite a little instruction.

Q. Will you tell the Court in your judgment

(Testimony of Charles A. Mullen.)

whether it is possible for an engineer engaged in the supervision and laying of asphaltic concrete to lay a pavement to get that as has been laid by Oskar Huber in this case, the claimed infringement of patent, without being instructed in some manner by literature or by a person competent in addition to what he finds in the patent?

A. I think he would be very largely confused by the patent, but if someone told him to make a good asphaltic concrete and lay it on the road two inches thick, which is the way he would make a good Portland cement concrete, I think he would be able to do it.

Q. Then if he would lay a pavement upon a street using the method they use in laying hydraulic concrete, would he get a result which they would claim would come under the broad claims of this patent? A. Well, I don't know.

Q. If he succeeded in getting a pavement laid according to the concrete method, would that pavement have density? [1032—477]

A. Every bituminous pavement from rock asphalt to asphaltic concrete has density. A pavement is dense when the voids are filled with mineral matter or bitumen. A pavement laid in that way would certainly be apt to have in the mineral aggregate itself a density of less than 20 per cent of voids.

From his study of the literature prior to 1900 witness states the attempt in laying hydraulic concrete was to get the aggregate graded from coarse

(Testimony of Charles A. Mullen.)

to fine so as to reduce the voids and give a greater volume of concrete to a given portion of cement. That is accomplished by reducing the voids to make it cheaper and you get the same strength. The cost of cement was a material item in the laying of hydraulic concrete; that is about the most expensive part every place witness has been, These specifications call for a 1–3–6 mixture. By having graded materials and mixing them 1–3–6 they get a greater volume of concrete to one barrel; therefore, it would lay more square yards and make a mixture that was so much cheaper; that is, instead of laying six square yards to the barrel of cement, we would lay 7 or 7.5 by the greater mixture. Witness thinks counsel misunderstood Mr. Schutte's testimony in that he claimed there was no hydraulic concrete pavements laid before approximately 1900, as Mr. Schutte said just the reverse, because he said at the time the bitulithic came they had sheet asphalt or concrete. Witness can't fix an absolute date for the laying of cement pavements; the cement people could tell that. Witness personally remembers the hydraulic concrete base under asphalt that was laid before 1900. Those bases were made just in the way that he described. The stone [1033—478] was preferred graded rather of a uniform size; for instance, you got a greater volume in a box, your box was say six times the volume of the cement, you got a greater volume in there and the cement and sand were put in and

(Testimony of Charles A. Mullen.)

you got a greater volume of concrete. The sand was graded too.

Q. Then was there anything new in the principle of laying asphaltic concrete over hydraulic concrete other than in one case you used cement as a binding material which crystallized as it became hard, and the other case you used asphaltic material which simply bound it together without crystallization?

A. I say, they are both the same with the difference that you mention, though there is a difference in one case; the rigidity is attempted; in the other case the material is used which only partly accomplishes rigidity, and when rigidity is desired, the Portland cement is used.

Witness has not read the specifications in the contract. Is handed the Green Springs Mountain concrete and is asked to read that part making the wearing surface. Is asked the question whether an aggregate of mineral materials consisting of the mineral aggregate shown in those specifications if placed together without a cementing material would have any stability, he stated if placed on a street it would have practically none. Stability is a relative term; if placed on a street without any cementing medium, it would simply be kicked all over, doesn't think it would be any better than the sand. Wagon traffic coming over it would produce holes and so on. He wants to qualify that. When [1034—479] it is put in for a macadam road the engineers are very careful to get a binding ma-

(Testimony of Charles A. Mullen.)

terial of clay or limestone dust to bind the water-bound macadam. The coarse aggregate, now known as bituminous concrete or the bitulithic type, is very similar in analogy to the surface of a water-bound macadam road, if you took it up and intimately mixed it and regraded it. The water-bound macadam is cemented together by the mix made of the limestone dust. In gravel roads they depend more on the clay and if it were not for that the roads would soon wear out. That is what gives stability to the macadam road. Sometimes a stone is put down and it is ground by the traffic and finally becomes the fine parts. An aggregation of rocks graded from one and a half inch down to dust and the specifications attached to the contract in suit, if it had no cementing material either of hydraulic cement or the water or the bitumen, for paving purposes it would have no stability. There is a certain stability to all materials due to the surface tension, somewhat similar to capillary attraction; that much it would have or the sheet asphalt would have over the material which had no binding particles, but put on the street it would have no relation to the pavement whatever. Asked if he could illustrate that stability which is or caused in sand by a cementing medium of any kind, witness said he didn't want to claim to be original because Mr. Dow stated it in an article published before 1900, in an article which he has here, but the fine sand constitutes a hard surface when the water laps over it, it is hard to

(Testimony of Charles A. Mullen.)

make an impression upon it; one can walk upon it and practically make no impression, and it is very hard [1035—480] even under a horse's foot where if you get up above where it is dry, you sink into it, and that is due to the surface tension—it is due to a certain amount of interlocking particles plus a certain tension between the mixture of stone and water and the surface of the grade. The hardness of a beach sand is due to the cementing material, which in that case is nothing but water. The principal stability under traffic on a road is due to the cementing material, and that he believes has been amply illustrated, even to the satisfaction of the plaintiff, in one or two instances. Then taking these samples of the Oskar Huber pavement offered in evidence if the asphalt by a chemical process was removed from it and nothing but the mineral aggregate remained, it would have some degree of stability but it wouldn't have enough to make it of any use on the road. It would not have any useful degree of stability on the road, not until the thing was broken down and the stone particles themselves began to form a cement, because you have the rigidity of the particles of stone, and rigidity is in relation to the type of stones in relation to the type of maximum stone laid and the thickness of the pavement surface being laid.

The COURT.—Your understanding is that the stability of that road depends upon the combina-

(Testimony of Charles A. Mullen.)

tion of the material and the manner in which it is put down? A. Your Honor, you can take a box—

The COURT.—(Interrupting.) Well, I am asking my question.

A. Yes, I do, but I was going to illustrate.

The COURT.—In other words, you agree it is a combination of the ingredients, the manner in which they are put down, is what constitutes the solidity of the road?

A. Yes, the complete pavement, not the aggregate alone that [1036—481] has no relation to the wearing of the pavement as it is used in asphaltic concrete. In other words, there are two forces operating, one from one end and one from the other. It is a question of where they meet. With reference to the Warren claim that a mineral aggregate combined in the proportions set forth in his patent graded from coarse to fine, with dust from 1 to 3 per cent, material from one-quarter inch down to dust being 10 to 30 per cent in the preferred specifications or 10 to 49 in the general claims, and material coarser than one-quarter inch being 50 to 80 has inherent stability of itself independent of the cementing material and that such a combination was a discovery is not true in regard to the pavement put down in the street except as it relates to the maximum size, being the size of the thickness of the wearing surface. In other words, if a wagon goes on one of those stones it has either got to crush it or ride it. The mineral aggregate independent of the cementing me-

(Testimony of Charles A. Mullen.)

dium has no relation to a pavement. The stability depending upon the larger sized stone which must either crush or dislocate in order to have any action whatever is hardly a stability in a pavement, except as it produces a rigidity more like Portland cement concrete, which is not desirable, and to get away from which we lay bituminous pavements.

Q. I will put the question again in this form: A combination of mineral aggregate, the largest stones of which are an inch and a half running down to dust in the proportions of 50 to 80 per cent, between one and a half inches down to a quarter, in proportion of ten to thirty per cent as stated in the specifications below a quarter down to dust, or as stated in the claims from ten to 49 from an inch and a quarter to dust and dust amounting from 1 to 3, does such a combination of material, the maximum of which is an inch and a half and the finest of which is dust all intermingled together, have inherent stability [1037—482] independent of the cementing material?

A. You mean as used in the paving art?

Q. Yes.

A. You are using the words "inherent stability" again. I don't know what it means. I know that everything has inherent stability.

Q. Does it have such stability as would stand traffic to such a degree, then, that combination from one and a half down to dust?

A. Yes, and all the other pavements I have mentioned, sheet asphalt, rock asphalt and everything

(Testimony of Charles A. Mullen.)

else, as a matter of fact they have and you can find the pavements, those pavements all over the country.

Q. I don't mean cemented together. I mean independent of the cementing material.

A. It depends upon the force applied. Now, in sheet asphalt you would get under a light load, a lighter load all in the sheet asphalt aggregate, you would get a marking, but under a bitulithic if a heavier load were applied, which would merely pack the sheet asphalt, it will dislocate the stones as carried on the side.

Q. You are talking about sheet asphalt which has asphalt in it?

A. No, I am talking even without it. If you go over it with a wide tire and heavy load you will simply pack the sand—

The COURT.—(Interrupting.) How do you have sheet asphalt without asphalt?

A. I don't know, your Honor, myself.

The COURT.—You are talking about it without the asphalt.

A. Well, this patent on the grading is mineral aggregate.

The COURT.—But we are talking about sheet asphalt.

A. No, I am talking about the asphalt aggregate without the bituminous cementing material. That is the question he asked.

The COURT.—This aggregate that you speak of

(Testimony of Charles A. Mullen.)

is in combination with the binder according to Clause 3.

Witness is unable to put his finger on that thing called "inherent stability." It exists in all pavements; it exists to a useful degree more than any other in the hot mix of bituminous pavements and it exists in a rock asphalt and sheet asphalt as well as in a coarser asphaltic concrete like bitulithic, and, to witness' mind, in a superior [1038—482(a)] degree. Bitulithic, because it goes into the large sizes is more rigid, more like the Portland concrete because of the sizes of the stone in the pavements, because they have relatively bigger volume of bituminous cement they are more plastic, but when it comes to actual use on the street there are incidents to-day in possibly many cities, but witness knows in Montreal where the sheet asphalt has shown its ability to stand heavy traffic with a bituminous binder so soft that witness doesn't believe that it has ever been attempted to use so soft a binder with a coarse asphaltic concrete, and he would certainly not recommend it. The incident of which he speaks showing the stability of the sheet asphalt aggregate, so-called, independent of the bituminous binder, which it has not, is a case where a well graded sheet asphalt mineral aggregate of the Richardson type was laid with a cement by mistake, of more than 170 penetrations; the penetration was about 200, but at 170 the penetrating needle struck the bottom of the pin. The reason they know it was about 200 is because they

(Testimony of Charles A. Mullen.)

know the general type of material which got into it by mistake. That pavement was three or four years old and was there without running and without shoving, and there has not been any repairs put on it yet; the only noticeable thing is a slight berm, which has formed where it runs up against the harder work of the preceding day, and that has been in use, witness thinks it was in 1919, and it is one of the principal boulevards of Montreal; it takes plenty of automobile traffic and the traffic coming in from outside. The paving feature of it may have some effect, that is, [1039—483] that the boulevard is 60 feet wide and there is no cross-street, so there is no putting on the brake, but the traffic in Montreal goes over it so fast or so thick in the summer when it is hot, in the summer afternoon when it is soft, and the farmers come in over it in the morning and go out in the afternoon. The penetration is fixed at 170 and it is about 200.

Adjournment.

June 1, 1922.

Testimony of CHARLES A. MULLEN, resumed.

Mr. Mullen desires to make a correction in his former testimony. Previously he referred to the diameter of the screen scale but what is meant is the aperture. It is frequently referred to as the diameter but that is not correct. The aperture is what showed in that graph and by saying a one-quarter inch diameter, what he meant was a one-quarter inch by one-quarter inch actual opening. Witness doesn't think the graph referred to has

(Testimony of Charles A. Mullen.)

any particular reference here because in their testing in all cases they have used the four mesh, that the paving is laid on the 4 mesh, so in the question it might come up that Warren used a one-quarter inch aperture or a one-quarter inch in diameter, using one-quarter inch material. Witness is asked to compare the mineral aggregate set forth in the claims and also the preferred specifications to ordinary macadam and he stated they differ, namely, that ordinary macadam has acquired a cementing medium. The aggregate here considered as just mixed and put on the street wouldn't have the stability of ordinary macadam, not by any means, but as it is pulverized and ground up and became ordinary macadam, of course it would approximate the stability of ordinary macadam. The mineral aggregate mixed up from an inch and a half rock down to dust without any cementing [1040—484] medium as to stability wouldn't compare with macadam until the material broke down. That is with water, you understand, ordinary macadam is made with water and the water in the pavement forms the binding. His answer is true as to the mineral aggregate described in Warren's patent from inch and a half down to dust, even though the rock was so graded by being placed through a cone by hand so that each size would fit into each succeeding size. Asked whether the claims of Warren's patent 727,505, in the light of the engineering knowledge, knowledge of road building as it was at the time this patent was

(Testimony of Charles A. Mullen.)

granted, are sufficiently definite to enable one to build a pavement in conformity with the way this pavement of Oskar Huber has been laid described in the specifications, Mullen stated it would not, that this patent wouldn't clearly indicate to compel the building of such a pavement. He stated that yesterday he pointed out that Claims 5, 6 and 11, to which counsel referred, or particularly 5 and 6 would apply to any bituminous street paving structure with a graded aggregate, no matter whether the maximum size was 1/200 of an inch, one quarter of an inch or up to the inch and a half of three inches, would apply to every one of them graded to make a packy mixture, or one in which the voids are fairly well filled. The claim for under 21 per cent of voids, it doesn't tell witness anything, because, as he explained, he can make up any number of mixtures beyond the patent which have less than 21 per cent of voids, and make it up so it would have less than 21 per cent of voids, make up a mixture of stone graded from 3 inches down to—well, [1041—485] it would be the same, but stone graded down to one-quarter inch, graded scientifically to one quarter of an inch, and then in all impalpable powder or stone dust, skipping the intermediate sizes between one quarter of an inch, and that will have less than 21 per cent of voids, so that doesn't help one any. Then witness goes to Claim 6, and he has shown here that it doesn't show what was indicated. That does indicate, however, that there is to be a larger per-

(Testimony of Charles A. Mullen.)

centage of coarse in the material. The specifications have a preferred claim, and in spite of the fact that there is one physical impossibility in Claim 3, that is, the patentee has claimed more than is physically possible, indicated in preferred claims, still that does indicate even more clearly what the patentee had in mind. Now, to find out and reading over the entire patent, the claim which gives him more information than any other claim is Claim 12. Claim 12 speaks of a mixture or wearing material of several grades. The ingredients of the depending sizes being so proportioned to each other and to the voids existing in all the grades so as to fill the voids to give an inherent stability in common with your binder. That claim doesn't indicate to witness how coarse the material is to be, but that he finds in Claim 3, and in the preferred specifications. Now, Claim 12 covers a physical impossibility when read literally, because it is impossible to have laid in the next preceding size into the voids to fill; a certain number will get [1042—486] there and a certain number will not. Claim 13 doesn't tell him anything of interest because that describes an entirely different grading, one which jumps from the coarse to very medium, so that the voids will not be filled with the next preceding size, but by sizes so small that they will be in contact as they come through what might be called the throats of the voids. In other words, if we take billiard balls and piled them up and put small balls in between so as to completely fill the

(Testimony of Charles A. Mullen.)

next size those balls wouldn't be in contact; but if one took bird shot and put it there so it would run all in between the voids in the larger sizes, then the bird shot could maintain a continuous contact. Now, Claim 12 is therefore, read literally, not a physical possibility; but counsel has handed witness this patent. Now, since the time it was issued Mr. Warren has done a lot of writing, and by turning to some of his publications witness finds a description of the cone method and how he determined the mineral aggregate which he proposed to use. Witness can either read that from one of his articles or probably state it. That is the one thing that tells witness how he meant that this pavement should be laid. It is not in the patent, but it amplifies and explains Claim 12. Mullen stated that he did not learn from specifications issued by Warren or Warren Bros. Company how to lay the pavement under the patent. He received the only intelligible idea of what Mr. Warren thought he invented, not from the patent, it doesn't state in the patent, and if one reads from the statement [1043—487] in trade publications, repeated a good many times, it becomes very clear what he meant. With that explanation witness can put together a pavement. Witness has never been able to find anything novel in the patent. There is no novelty in inherent stability; there is no novelty in mixing materials together into coarser sizes. In fact he finds that Mr. Warren says in line 43, the last word after the semicolon, "but by so doing

(Testimony of Charles A. Mullen.)

the smaller percentage of voids that has been possible has been 21 per cent of the aggregate," while by the use of the larger grains or pieces, say, up to those which will pass through a 2 inch ring, in other words, he recognizes grading.

Q. Is that statement of his true and yet possible as having voids of less than 21 per cent as stated in that patent?

A. At the time of his invention?

Q. Yes, in materials other than the materials which he describes?

A. Oh, it was true; and you could get it with any number of combinations. I have a table here with any number of combinations. You can take uniform stone and concrete and sand and get less than 21 per cent which is plain concrete sand, grading the stone to get it uniform and with the largest possible percentage of voids. Now, taking it from a crusher or any way you would find it, taking the maximum disadvantage according to the theory of this patent, and with uniform sizes of stone and concrete sand, you get 21 per cent of voids with any number of other combinations, and it could have been done any number of years ago [1044—488] Witness this morning compared the 1903 patent with the 1901 patent, reducing his analysis to writing. The 1901 patent, 675,430, specifies that there shall be between 3 inches and one-half inch, that is, passing the 3 inch and held on the one-half 70 parts, which, when reduced to percentage is 59.3 per cent. It says that between the one-half

(Testimony of Charles A. Mullen.)

inch and the one-tenth inch there shall be 20 parts, which when reduced to percentage it is 16.95 per cent. It says passing the one-tenth and held on the one-fortieth there shall be 20 parts, which when reduced to percentage is 16.95. It says that between one-fortieth and one-eightieth of an inch there shall be four parts, which when reduced to percentage is 3.4. It says passing the one-eightieth and held on the one-two hundredths there shall be three parts, or 2.5 per cent. It says that passing the 1/200 down there shall be one part, which figures out 9 per cent. In other words, a total of 118 parts reduced to 100 per cent. Now, examining that in the light of the 1903 patent, No. 727,505, we run into this difficulty, that in the 1901 patent there is no one-quarter inch in diameter or 4 mesh sieve mentioned. The jump is from one-half inch to one-tenth inch, so witness has divided both on the one-half and on the one-tenth and he finds that no matter which way it is divided it falls within Claim 3 of the 1903 patent, No. 727,505; in other words, divided on the one-half inch screen there is 59.3 above, and divided on the one-tenth inch screen there is 76.25 per cent above, both of which are within the 50 to 80 per cent of the 1903 patent. [1045—489] Then divided on the one-quarter to 200 mesh—no, then dividing on the 10 mesh to 200 there is 22.85 per cent, and dividing on the one-half to 200 there is 39.8 per cent, both of which are within the 10 to 49 per cent stated in Claim 3 of the 1903 patent. There is provided here .9 per

(Testimony of Charles A. Mullen.)

cent passing a 1/200 inch in diameter that is not within the claim of the 1903 patent. Now, in that it is only 90 per cent of the minimum required, but saying approximately 1 to 3 it is a question whether .9 would be approximately one. Witness has this information tabulated which illustrates the matter.

Which tabulation is thereupon offered and received in evidence and marked Defendant's Exhibit "A–40."

Q. Mr. Mullen, you have a pamphlet or a book published by Abbott?

Mr. MONTAGUE.—Is that A–37?

Mr. LILJEQVIST.—No, we have not pleaded in our answer.

Mr. LYMAN.—We object to that, if your Honor please. We don't know anything about it.

Mr. LILJEQVIST.—This is showing the state of the art at that time. Had we known we could have pleaded it of course.

Mr. LYMAN.—We have never seen it, your Honor.

Q. (By Mr. LILJEQVIST.) When did you first see that book?

A. I first saw this particular book about a year ago, when I went to the office of Mr. Walter V. Trenford in Brooklyn, New York. I was inquiring of him concerning some pavements [1046—490] laid in Brooklyn by his father and other contractors.

Q. The particulars are not material. Had you

(Testimony of Charles A. Mullen.)

before that time ever seen another copy or copies of the same book; if so, where?

A. I have seen other copies of this book in my father's possession a great many years ago.

Q. About when before?

A. When I was about 15 years old. That book is quite characteristic.

Q. And that is the same book as you saw in the possession of your father?

A. Yes. There may be among his papers now, but the papers are down there.

Q. The pencil memoranda showing in this book was not in the copies of your father's?

A. No, those pencil memoranda were explained to me by Mr. Trenford, and they show quite clearly by those that Mr. Abbott intended to republish and make some corrections, none of which seem to be very material. Now, there are some other marks in here which I made myself, little light lines in lead pencil drawn under special words and phrases and numbers in the margins, surrounded by circles. Those are marks of my own.

Q. Do you know when this book was published?

A. I only have the date, 1875.

Mr. LYMAN.—Just a moment now; he asked if you knew when that book was published.

A. This particular book? [1047—491]

Mr. LYMAN.—Yes, you were not born in 1875, according to your testimony.

A. You are quite right.

(Testimony of Charles A. Mullen.)

Mr. LILJEQVIST.—Of course, I am referring to the book.

Mr. LYMAN.—Well, don't attempt to prove dates by the witness.

The COURT.—The book shows for itself, I suppose.

The WITNESS.—It says here on the front cover and inside, "Brooklyn, E. M. Whiting & Co., 354 Fulton Street, 1875," and this has been crossed out, the parts making corrections and changed in lead pencil to read 1876, apparently for republication.

Mr. LILJEQVIST.—Now, we offer in evidence this book for the purpose of showing the prior art, to show what was old and what was new, to show that there was nothing novel in this patent, and for the purpose of assisting the Court in an interpretation of the patent.

Mr. LYMAN.—Now, if your Honor please, we object to that book, we have never seen it, although it has apparently been in the possession of counsel for some time, and even though he was to show us what he had, he has never mentioned it to us at all; we don't have the first idea what the book is; there is no evidence of the date of its publication.

The COURT.—Very well.

Q. (By Mr. LILJEQVIST.) Just one second; when did you first show me this book, Mr. Mullen; how many days ago?

(Testimony of Charles A. Mullen.)

A. Why, I brought it from Montreal with me on this trip; you did'nt have it before that.

Mr. LILJEQVIST.—I couldn't show it to counsel because I didn't know of its existence myself.

Mr. LYMAN.—Let him answer.

Q. (By Mr. LILJEQVIST.) When did you come here? [1048—492]

A. I left there seven weeks ago.

Mr. LYMAN.—When did you show it to Mr. Liljeqvist?

Mr. LILJEQVIST.—What are you trying to do, impeach my good faith with you?

Mr. LYMAN.—I am trying to tell you that if you had something that you were going to put in here, you ought to have shown it to me.

Mr. LILJEQVIST.—I showed you everything I had, didn't I, before this trial commenced?

Mr. LYMAN.—I don't know that you did.

Mr. LILJEQVIST.—Everything I have introduced.

Mr. LYMAN.—Up to the present time with the exception of that Leverith thing, and you refused to show it to me.

Mr. LILJEQVIST.—I gave you a copy of that.

Mr. LYMAN.—I don't know whether you gave me a copy or not, you gave me a typewritten thing. Anyway, I object to the book.

The WITNESS.—That copy can be returned to me, Mr. Liljeqvist?

Mr. LILJEQVIST.—Yes, sir. We ask leave to substitute a copy of that book, may it please the

(Testimony of Charles A. Mullen.)

Court, and return it to its owner after counsel has inspected it.

Mr. LYMAN.—I don't know whether we consent to that or not.

Mr. MONTAGUE.—We understand that this goes in over our objection?

The COURT.—Yes, over the objection. I don't think it is competent, though.

Mr. LILJEQVIST.—We save an exception under the rule. [1048 a—492 (a)]

The WITNESS.—Well, Mr. Liljeqvist, just kindly arrange so that I can get the book back for the Montreal office.

Mr. LILJEQVIST.—We will. We ask leave of the Court to substitute or to make a copy of it.

The COURT.—It may be shown in the record as counsel desires, I suppose.

Thereupon the book above referred to was offered and received in evidence and marked Defendant's Exhibit "A–41."

Witness was asked to interpret Claim 3, from his knowledge of the paving business and experience and he stated Claim 3 is so broad that it doesn't at all restrict one to laying a type of pavement which Mr. Warren has described in his patent, and his specifications, and as he can construct so many pavements which do not mean his idea of having a dense pavement under that claim, that the claim merely can be said—well, you might just as well try to describe that table by saying it is in this room; and he might add that there is no relation,

(Testimony of Charles A. Mullen.)

no necessary relation between that grading and 21 per cent of voids. Witness can't find exactly what Warren meant in this patent; that patent is so broad and ambiguous and contains even such physical impossibilities all the way through that witness don't see how anyone would be expected to find in that what Warren intended to lay; and the only way in which he could get a real idea of what Mr. Fred J. Warren meant by that patent was by reading [1049—493] articles published afterwards and even reiterated by Mr. George D. Warren, he thinks, in his statement about a pavement laid in 1920. The original statements were made by Mr. Fred J. Warren and included in several articles, witness thinks, or published in several magazines of development of bitulithic pavement. Witness has one here. That does give some clear idea and they put together a pavement in accordance with that idea, and it is principally noteworthy by the fact that it doesn't agree with the pavements laid.

Q. (Interrupting.) Will you produce papers offering in evidence the plat wherein you show the magnification of the particles composing the sheet asphalt?

A. I think I gave you that.

Witness then referred to a graph made up from a sample which he took on Vermont Avenue, sheet asphalt magnified, is magnified by degrees; any one of those show the same relation of particle to particle, the same filling of the voids. It is the same

(Testimony of Charles A. Mullen.)

graph illustrating what he has heretofore testified to.

The graph is thereupon received in evidence and marked Defendant's Exhibit "A–42."

Witness took samples in Washington—two from Vermont Avenue, two from Pennsylvania Avenue, and two from Massachusetts Avenue. Sample number 2 was taken with the assistance of two laborers on Tuesday morning, July 27, 1920, between 10th and 11th from the westerly side of Vermont Avenue between H and I Streets, Northwest, Washington, D. C., at a point 13 short paces, about 26 feet, or about one-third of the way across the roadway from the westerly curb. The northerly side of the cut was [1050—494] about opposite the middle or the center of the main entrance to the War Risk Building. This sample is across the street approximately from the one he testified to yesterday. Vermont Avenue is about 40 short paces or about 80 feet between curbs at this point, so that parallel lines intersecting the curb from which one of the samples was taken would be about 14 short paces or about 28 feet apart and parallel lines at right angles with the curb, so that they would intersect the location from which the samples were taken, they would be about 12 short paces or about 24 feet apart, sample No. 1 being southeasterly of sample No. 2. Sample No. 2 was, roughly estimated, about 18 by 18 inches in surface area and about of the same thickness and of the same gen-

(Testimony of Charles A. Mullen.)

eral appearance as Sample No. 1. The photograph shows. There were two samples taken on Massachusetts Avenue. Witness went there next. These samples were numbered three and four. Sample No. 3 was taken by witness with the assistance of the laborers on Tuesday afternoon, July 27th, 1920, between 1:30 and 3:30 o'clock, from the southerly side of Massachusetts Avenue, between Thomas Circle, which is at the intersection of Fourteenth and Fifteenth Streets, Northwest, Washington, D. C., at a point six short paces or about 12 feet from the southerly curb and about 12 short paces or about 24 feet from the northerly curb and opposite the easterly end of the place on the northerly side of Massachusetts Avenue or about 12 feet westerly from the end of the building on the southerly side. The resurfacing or sheet asphalt and binder section of this sample came loose and was removed, [1051—495] leaving only the old Evans coal tar pavement, from which one corner broke in lifting it up. Sample No. 4 was taken by witness with the assistance of the same laborers on Tuesday afternoon, July 27th, 1920, between 1:30 and 3:30 o'clock from about the center of the road in Massachusetts Avenue between Thomas Circle, which is at the intersection of Fourteenth Street and Fifteenth Street, Northwest, Washington, D. C., at a point on the protracted lot line, between houses No. 1426 and 1428. This sample in every way resembles No. 3, even to the lost one corner in removing, and the loss

(Testimony of Charles A. Mullen.)

of the wearing surface which was laid as a resurfacing. From Pennsylvania Avenue two samples were taken, No. 5 and 6. Sample No. 5 was taken by the witness with the assistance of the laborers on Tuesday afternoon, July 27th, between 3:30 and 5:00 o'clock, from the northerly side of Pennsylvania Avenue between 25th and 26th Streets, Northwest, Washington, D. C., at a point opposite a manhole cover in the sidewalk on the northwesterly corner of 25th Street and about five feet easterly of the westerly building line of house number 2500, on the southerly side of the street, this point being ten short paces or about twenty feet from the northerly curbstone and six short paces or about twelve feet from the car rail. That sample was taken on the northerly side of Pennsylvania Avenue; by that witness means it was north of the car rail. Sample No. 6 was marked out for cutting by Mr. Mullen on Tuesday afternoon, July 27, 1920, at about five o'clock, to be removed at [1052—496] once by the laborers named above and by them taken to the corporation yard along with the other five samples, to be delivered into the custody of Mr. Beall. The location that was marked as noted above was on the northerly side of Pennsylvania Avenue, that is north of the street car track between Twenty-fifth and Twenty-sixth Streets, Northwest, Washington, D. C., at a point thirteen short paces or about twenty-six feet from the northerly curb line and three short paces or about six feet from the car rail closest thereto at

(Testimony of Charles A. Mullen.)

the protracted building line between houses number 2505, which is a tailor-shop, and house number 3507. Witness did not remain to see this sample dug out, but marked it for identification and left instructions with the laborers as noted heretofore. The two samples taken on the same street looked very much alike, practically identical, and witness took the two samples for the very purpose of having some evidence to show that they represented what was there, not that one sample was merely accidental. With reference to the pavements laid by Warren Brothers under patent 727,505, witness has seen a great many of them, tested a great many and has sawed and demonstrated them.

Q. I hand you herewith a sample marked Defendant's Exhibit "A–32," testified to by Mr. Hall, testing engineer, as having been made up from specifications of the Averall patent. I ask you to examine this sample and state from your knowledge of the bitulithic pavements laid by Warren Brothers or under their direction, whether this sample upon such examination looks like that sample? [1053—497]

A. Yes, I think that that is a type of pavement which they will claim fell within their contract that the contractor laid.

Witness thinks that sample would wear, though he is on record as preparing the fine mix, but any mix from fine to coarse which was dense and fairly well graded would certainly stand up and have inherent stability for years, providing

(Testimony of Charles A. Mullen.)

the cementing medium is what it should be. In other words, he never made a pavement yet that didn't depend on the cementing medium. Has never known a pavement yet that did not depend on the bituminous cement. If the asphalt were either too hard or heated too much, the pavement would be inclined to crumble under impact. If the asphalt were too soft or got too soft in summer, the pavement would be likely to rough and roll. If a pavement of any grade of maximum sized particles were laid with marbles, they would roll quicker than a sample laid with particles that would interlock. That is true of the entire bituminous mixture, the packy mixture gives a stability to all of them, but it is relative in each case. Witness is shown sample of pavement laid on Highland Avenue, identified by the specifications at Pittsburgh, the sample which seems to be crumbly and brittle, and he stated the quality of the cementing medium had something to do with its brittleness. There is another point that he notes in that, and that is that it doesn't seem to go down to the very finest particle in grading; it may have some too, but it doesn't seem to go all the way down; but in Warren's Canadian patents [1054—498] they had the mixture which witness thinks approximates that. Witness can't tell without a chemical analysis what the cementing medium in that sample is; he thinks it is tar, it might be a wrong guess. The literature on the subject shows that they had a great deal of difficulty between the earliest stage of tar concrete

(Testimony of Charles A. Mullen.)

pavement up—well, they haven't gotten out of it yet. In getting a tar and heating tars of known consistency and known, what he might term staying qualities. Witness has no direct knowledge of the specifications of the work of laying the pavement on Michigan Avenue in Chicago; he saw the pavement in 1910 and 1911. It was very badly rotted out. The appearance the latter part of 1910 to 1911, it had a coarse aggregate. It resembled bitulithic in its mineral aggregate. When he saw that pavement it was in ruts. Michigan, of course, is a very heavy traffic street, but the automobiles and traffic had made ruts and then they tried to roll those out and put this other material in there. Has no direct knowledge of how that was resurfaced or fixed over. The cementing material was bituminous; doesn't know whether it was asphalt or tar.

Q. Now, I show you, Mr. Mullen, a sample of the pavement marked Defendant's Exhibit "G," known as the McGovern—as the sample taken back of McGovern's undertaking establishment in Denver. The evidence shows that this sample was laid in the year 1892 and remained subject to the traffic of an alley on which vehicles of all kinds and descriptions from heavy to light, including some pedestrian traffic—which pavement was subjected to the traffic from 1892 to [1055—499] 1922, the traffic consisting of vehicles from heavy trucks and coal wagons down to lighter traffic. The sample is before you and I wish to ask you to state to the Court if that sample subjected to such traffic

(Testimony of Charles A. Mullen.)

from the year 1892 to March, 1922, whether that sample had the stability which is purported to be mentioned in Warren's patent 727,505?

A. I would say that it had.

Q. I also show you another sample from the same alley that the evidence shows was laid in the year 1892 and which was subjected to the same kind of traffic mentioned, which was taken up in the year 1909 and ask you if it had the same kind of stability, or had the stability attempted to be described by Warren in patent 727,505?

A. Nearly as I can get it out of the patent.

Q. I hand you herewith a sample marked Defendant's Exhibit "A–29," testified to as having been laid as nearly as could be under the specifications of the Warren 1901 patent, and ask you to examine that and state from your knowledge of paving whether that wearing surface would give the stability mentioned in patent 27,505, in your judgment?

A. I think so. That is, as near as I can get the stability from the patent.

Q. I ask you whether this sample of a pavement laid by Mr. Hall under the Averell patent is a fair sample, or otherwise, of pavements laid under 727,505, wherein the mineral ingredients is gravel instead of crushed rock?

A. Yes, that would have stability indicated by the patent as near as I can tell.

Q. Does it resemble, in a fair degree or othewise, pavements laid with gravel under patent 727,505, if you know? A. I think so. [1056—500]

(Testimony of Charles A. Mullen.)

Cross-examination.

(By Mr. LYMAN.)

Counsel asks witness to refer to his photographs of the samples he took from Pennsylvania Avenue and state whether the asphalt surface with which it was reinforced some time after 1870, appears in the photographs. Witness states that it does not appear; that is a pavement apparently of free surface. Witness thinks the pavement shown in his photograph is as it was originally laid. That applies to both his photographs on pages 12 and 13 of the book of photographs exhibited. In his samples of Pennsylvania Avenue there seems to be a base of large broken stones, over which has been laid a course of asphaltic concrete, over which has been laid a course of very much finer asphaltic concrete, which is probably with a maximum of one-quarter inch. The bottom layer is very clearly distinguishable because of the large stones. Then there is still another layer on there of probably one inch. On top of that is, witness thinks, about a half inch, less than a half inch of fine mixture. The two top mixes, he thinks, are intimate mixtures; the bottom he thinks is just thrown in asphaltic cement. Counsel refers to sample of Pennsylvania Avenue taken by Mr. Hall marked Defendant's Exhibit "A–19" and witness states that sample doesn't look like the photographs he has produced. Witness' photographs do not show the top layer. The top layer broke loose from the sample witness had and was lost, about an inch at the top; it

(Testimony of Charles A. Mullen.)

looked just about like that. There is no way of telling definitely what was the original pavement. His sample separated at the point the plaintiff's counsel indicated. Now then, there is this layer, and that layer has a thin surface of some sort. What it may or [1057—501] may not have had above that witness can't tell; when that layer was put on it wasn't fused by heat on his sample and the bottom, it seems to be fused by heat in Mr. Hall's sample. He can't tell if it is a recent addition to the pavement. If the bottom part there was laid, say, today and it was windy and dust blew over it very heavily and the upper part which is on Mr. Hall's sample, but not on witness' sample, were laid to-morrow without properly cleaning it, it might have that separating line to cause it to come apart. The layer which peeled off in witness' samples was an asphalt surface; it has not the top or the maximum size.

Q. Is it an asphalt surface?

A. Bitulithic is an asphalt surface.

Q. Is it a sheet asphalt surface?

A. No, that is not sheet asphalt; sheet asphalt is approximately—

Q. Approximately what?

A. One-tenth of an inch down.

Q. Ten mesh down?

A. Well, it is close enough to make no difference. In producing these photographs, he read exactly from a report which he had made to the attorney in the Montreal case. He was only asked before

(Testimony of Charles A. Mullen.)

to read the locations. Asked to read the part that referred to that part scaling off, Mr. Mullen read as follows:

"I was very careful to pick out spots where the"—this is paragraph 16 in this report—"where the surface indications left no doubt in my mind concerning the authenticity of the top course being that of the original resurfacing of 1893; and marked out, initialed and numbered two sections for removal, remaining to see the work of the cutting and barring out of sample number five completed, and placing my initials and the number of the other sample upon it in yellow crayon for purposes of identification, as I had also done with all the foregoing five samples. [1058—502] Sample No. 5, which was taken at a point where the sheet asphalt surface was worn off, leaving the binder course exposed, seemed normal. The binder course, about one inch thick, rested loosely upon about five or six inches of old coal-tar pavement of the bituminous concrete type, very similar to that found on Vermont Avenue, both being scarf pavements. This binder course on sample 5 separated from the old coal-tar pavement, and I ordered it discarded; and I left crayon with the laborers, telling them to try to save binder course in sample six, but, if they could not, to discard it in that case, also, and, in that event, to mark a big figure six on the surface of the coal-tar pavement underneath."

They brought in the binder course. It had separated in his sample; as they bored it out, it

(Testimony of Charles A. Mullen.)

had separated. By binder course witness refers to the upper part about an inch in thickness on this sample. The reason it was left off on his samples is because his samples separated so that he was by no means sure, had no way of knowing. As a matter of fact, in his opinion, that is not a part of the pavement. Others may hold other opinions but his opinion is that was a part of the pavement subsequently laid to the original pavement there. If they were to look for the original pavement they would look for the part that is shown in witness' photographs. Witness was connected with the paving department of the city of Milwaukee; from there he went to Schenectady, New York; from Schenectady he [1059—503] went to New York, living with his father but contracting independently of him, and about the first of July, 1916, he went to Montreal. He appeared as a witness in a case some years ago, in which Warren Brothers Company, or the Bitulithic Paving Company, Ltd., was suing the City of Montreal for money for certain pavements. Witness testified for the defense. The question at issue there was whether a certain pavement laid by this Bitulithic Paving and Contracting Company was a good pavement and whether the city had the right to withhold certain money it was holding as a guaranty for it. The ultimate decision in that case was in favor of the city paying the money to the Bitulithic Paving Company. It was carried on appeal and upheld by the appeal court,

(Testimony of Charles A. Mullen.)

Chief Justice LeMarque (?) only dissenting. [1060—504]

Q. You are familiar with the decisions of the courts in those cases?

A. I have read them with a great deal of interest.

Mr. LILJEQVIST.—I object as immaterial.

Q. I will read you an extract from the opinion of Mr. Justice Greenshields, in the Court of Appeals, and ask you if you remember this as having been the decision of that court—

Mr. LILJEQVIST.—(Interrupting.) I object as incompetent, irrelevant and immaterial and nothing to do with the issues in this case, has no bearing to any of the issues of the case here, whether a pavement laid in Montreal was good or bad. I haven't brought it out on direct examination.

The COURT.—It only goes to the credibility of the witness, that is all, and the weight of his testimony.

Mr. LYMAN.—It is to the weight of the testimony of the witness.

A. That is just it. Now, your Honor, if I may be permitted—and I suppose I will—to state what happened to that pavement after the court got through with it this spring, and to show by witnesses here what happened, and to show what money the city has already appropriated to pay for it, absolutely upholding my expert opinion, then I shall be very glad to have the plaintiff go ahead and show everything in this decision; also, if I may

(Testimony of Charles A. Mullen.)

explain certain matters in connection with that case which do not appear in the record, I haven't any objection to their putting the entire record in, as far as I am personally concerned.

Mr. LILJEQVIST.—I object to it as incompetent, irrelevant and immaterial. [1061—505]

The COURT.—The record has nothing to do with this case at all. It only goes to the credibility and weight of the testimony.

Mr. LYMAN.—It is only the remarks of the judge about this witness, your Honor.

Mr. LILJEQVIST.—I think that is a very improper method of attempting to injure a witness, and I don't think it has anything to do with the case.

The COURT.—I suppose the Court could read it. It is a reported case, anyway.

Mr. LILJEQVIST.—I don't know.

A. I don't think it is a reported case, but, as I say, I have no objection to it being before the Court—

The COURT.—(Interrupting.) Let's see what he says.

Mr. LILJEQVIST.—The defendant wishes to save an exception.

A. Provided I make a clear statement of the matter afterwards.

The COURT.—It is not a question if you object or not. You will answer the questions that the Court says, and not interpose your own objections or nonobjections. Your counsel will do that.

(Testimony of Charles A. Mullen.)

A. I will say that I am not a very expert witness. This is the second time I have been on the stand.

The COURT.—All right.

Mr. LILJEQVIST.—I object to it as not proper cross-examination.

The COURT.—I think it is proper cross-examination. It goes to the weight of the testimony.

Mr. LYMAN.—Now, I was going to read this to the witness and ask him if he recognized it as having been in the decision.

A. I would like to get hold of my own papers, so I can check it. I brought that along. What paper do you propose to read from?

Q. Mr. Justice Greenshield's opinion.

A. You are aware, aren't you, that I never saw Mr. Justice Greenshields and he never saw me?

Q. I am sure I don't know, sir?

Q. I will read the most important parts, and you can check those.

Mr. LILJEQVIST.—I ask him to simply take it in as an exhibit [1062—506] and over my objection, if he wants to do it. I object to his reading it into this record.

The COURT.—All counsel desires to do is to ask the witness about it.

Mr. LYMAN.—Beg your pardon?

The COURT.—I say that all that counsel desires to do is to ask the witness about it.

Mr. LYMAN.—Now, the Court said this, did it not: "The most serious attack upon the condition of the work is made by one Charles E———"

(Testimony of Charles A. Mullen.)

A. (Interrupting.) Wait a minute. Where is that? Tell me the page.

Q. On the condition of the work.

A. I think I have it underlined.

Q. "The most serious attack upon the condition of the work" A. Yes, go ahead.

Q. (Continuing.) "—is made by one Charles E. Mullen"—

A. (Interrupting.) Charles A. Mullen.

Q. (Continuing.) "—Charles A. Mullen. He describes himself as a 'consulting paving engineer,' aged thirty-seven. He says he is director of the paving department of the Milton-Hersey Company, Ltd., and has been in that occupation since July, 1916.

"He knew nothing about the contracts or work to be done under the contract until the 23d of June, 1920. On that date he received, or his company received, from Mr. Doucet, the director of the Public Works Department of the City of Montreal, a letter, which in part reads as follows: "—then there is nothing material in that letter.

"Upon receipt of this letter he secured the services of a Mr. Gilson. Mr. Gilson frankly admits that he is not an [1063—507] expert in paving, and in fact knows nothing about it, and all he was told to do was to make what the witnesses call 'field-notes.' He was told how to do this and how to proceed with this work by Mullen.

"It might be observed here that Mr. Mullen's past history as a paving expert does not greatly

(Testimony of Charles A. Mullen.)

redound to his credit. In his cross-examination as to his work as such in the city of Milwaukee, it would leave the impression that at that time, at least, he had much to learn.

"The official report as to his work in the city of Milwaukee contains a statement with respect to bitulithic pavements laid under his directions, to the following effect:

"' 'And if one can judge from the behavior of the said pavement under somewhat trying conditions, it has inherited all the vices of both of its parents and none of the good points of either.'

"Mr. Mullen launched an adverse criticism against the work done by the respondent. He did not confine himself to the necessity for repairs, but he went the whole length, and said, that the whole work had to be done over again. He said that in order to make the street pavement acceptable 47,756 square yards would have to be remade at a cost, says he, of from $2.00 to $2.50 per square yard.

"He does get some support from the witness Blanchard, but one cannot help but conclude from reading Blanchard's testimony, that it is largely inspired and suggested by the witness Mullen."

I think that is all. That, of course, was the statement of Mr. Justice Greenshields, was it not? [1064—508]

A. Yes, but there—

Mr. LILJEQVIST.—(Interrupting.) I move to strike out the part that counsel has read as incom-

(Testimony of Charles A. Mullen.)

petent, irrelevant and immaterial, and not proper cross-examination.

The COURT.—All right.

Mr. LILJEQVIST.—Has nothing to do with the issues in this case.

Redirect Examination.

(By Mr. LILJEQVIST.)

Witness' expert opinion in that case is absolutely upheld, and with a vengeance, by what has happened since, and the Court must feel that it was misled to-day in rendering such a decision and abusing a young man, who happens to be young through no fault of his own and is engaged in the paving business. Witness does not know how much the city spent for repairs of this pavement, but they repaired this bitulithic pavement on Sherbrooke Street in Montreal with sheet asphalt last year, so that last fall all the holes were filled up and it was safe for riding. This spring, when the snow removed, the pavement was the worst thing he has ever seen still called a pavement. It was worse than he thought it would be and worse than he testified. He has pictures of that pavement taken both before and after the decision rendered. Witness produces true photographs of that street as of April 26, 1922, which was after the confirming of the decision. He might say that the decision was confirmed while the snow was still on the street, and, of course, the Court had no knowledge, either within the court or without it, of its condition.

(Testimony of Charles A. Mullen.)

Said photographs were thereupon offered and [1065—509] received in evidence and marked Defendant's Exhibit "A–43."

"Mr. LILJEQVIST.—Sometimes errors are made in judicial proceedings.

"Mr. LYMAN.—We shan't undertake to go into the merits of that controversy.

"Mr. MONTAGUE.—Introducing them all as one exhibit?

"Mr. LILJEQVIST.—We might as well, yes. Now, what is the name of that street?

"A. It is Sherbrooke Street.

"Q. Did you show Mr. Hall that street when he was in Montreal this spring?

"A. I did; I took him from end to end of it.

"Q. Did you show me that street while we were in Montreal?

"A. I did; I took you from end to end of it. Prior to the decision this street was patched up, but its history was such, as I had personally known it, that I knew that this patching would not hold.

"Mr. LILJEQVIST.—That is all, Mr. Mullen.

"A. Well, I would like to identify these pictures to make that clear.

"Mr. LILJEQVIST.—Pardon me. When he asked you that question you said you wished to make some explanation in reference to that matter. If you desire to do so, make your explanation.

"A. Your Honor, might I be permitted? The counsel for the—

(Testimony of Charles A. Mullen.)

"The COURT.—(Interrupting.) What did you want to do?

"A. I want to make a statement in connection with this case.

"The COURT.—You can make a statement—any statement that [1066—510] is pertinent."

Mr. Mullen stated he wished to make a statement explaining this matter, and this was as follows:

"I think it is pertinent to my reputation as a paving engineer, in the courts, at least. When I went to Montreal in the year 1916 this pavement had already been laid. I noticed defects in it, and in talking with the paving men they told me it had just been laid, I think, in 1913, '14, and possibly the last was finished in 1915. I understand that a part of it was resurfaced or skincoated the next year, because something went wrong, a large area. I myself saw holes in that street every year from 1916 until the pavement was repaired for final acceptance, which, I think, was in 1920. In 1920, the plaintiff, or the plaintiff's subsidiaries there—the plaintiff prosecuted the case against the city—patched it up. Now, this was not the first patching in five years. It had been patched and patched and patched and patched, and then they offered it to the city for acceptance. The director of public works—one day I was in his office—asked me about it, its acceptance, and I told him that though it had been patched up—I described it as being doctored up—that the history of the street as I had known it had shown that it was not a good pavement, and

(Testimony of Charles A. Mullen.)

that it would go to pieces the next year and [1067—510(a)] the year following, and that within a couple of years the city would have to take it up extensively and relay it. The city asked me to make a report, and which I did, in writing, and which is in that record, or is in the record of that case, and that is about the way I described it, that the pavement should be condemned on its record as indicating its present condition internally, regardless of the appearance after it had been patched.

"The third assistant city attorney, I think it was, one of the junior members of the city attorney's office, attempted to handle the case, being rushed in at the last minute, and when I went into court, though I had asked for corroborating experts, the city had not seen fit to spend the money—when I went into court on the date of the trial I found there, lined up against this young city attorney, Mr. Elliott, of a reputable firm, and also of mature age, in Montreal, and a man of recognized ability; I found Mr. Head there; and that did not seem to be enough, so they had hired about the best lawyer in Canada, Mr. Eugene LaFleur (?), and, I will say, one of the most courteous attorneys by whom I have ever been cross-examined; Mr. LaFleur acted for the Grand Trunk stockholders, or the government, I have forgotten which, in this matter of the government taking over the Grand Trunk Railway, and is now acting, I think, in that very big case of the bank failure up there, the failure of the Merchants' Bank. He is one of the most prominent lawyers

(Testimony of Charles A. Mullen.)

in Canada. They brought into court their Mr. Perkins, who swore that this was a first-class bitulithic pavement under these [1068—511] contracting specifications. They got from the city of Ottawa the city engineer of Ottawa, and the city engineer—former city engineer of Hamilton, who came over there just before the work was offered for acceptance, and was over there, I understand, afterwards, and who is not a specialist in paving at all, though a recognized engineer—his knowledge of paving came incidentally with his other municipal work, covering all fields—; he swore if that pavement were offered to him in the condition in which he had seen it he would have accepted it. They put on construction witnesses, one of whom said such a pavement should last twelve years, and they put on quite a line of witnesses. The only information that I had, as I remember—that we had, the city, was myself, Mr. Blanchard, who was the engineer of roads, and Mr. Gilson, who never pretended to be an expert; he is one of my chief inspectors; he is familiar with a great deal of the work. The decision went against us, and I think the Supreme Court should be ashamed of the decision it wrote, and I think if they will consider these pictures to-day and what has happened there in the city they will be ashamed. Your Honor, this picture is repairs being made—this picture is marked "Champlain Street, looking west"—will you examine it? The cut out places, from which you can see the foundation, are where it was in such bad

(Testimony of Charles A. Mullen.)

shape that they could not save any of it. The black spaces are where they are going to skin patch it. That is on a section of a street by a park, where the traffic is very light." [1069—512]

Witness still reiterates his opinion given in that case, that it was a bad job and should not have been accepted, and he will state that a witness has never been more corroborated by the facts that have happened after the case as has been in that case. The photographs produced were taken recently.

Mr. LYMAN.—Have you got any photographs used at the trial of that street?

Mr. LILJEQVIST.—No, sir, those are not photographs used at the trial.

A. No, these are photographs taken recently.

The WITNESS.—Your Honor, may I simply state this matter, that the city has had to appropriate twenty thousand dollars for temporary repairs of certainly not over fifty thousand square yards of surfacing. Some little of it may have been for the concrete foundation—for temporary repairs to carry that street over until we can resurface part of it.

That was just before he left. They appropriated one day, and the next day they got busy getting this out. The portions that the city has had to cut out recently are portions of the same street the court said was a good street, and the same street that the plaintiff in this case put witnesses on the stand to swear was a good street. And the city has appropriated this spring the amount of money he has

(Testimony of Charles A. Mullen.)

indicated, to repair the identical street which the Court said was a good street last year.

Mr MONTAGUE.—(Interrupting.) Will counsel allow me to make a suggestion?

Mr. LILJEQVIST.—Yes.

Mr. MONTAGUE.—The amount of money that the city has appropriated can hardly be proved in the witness' testimony.

The COURT.—It is very doubtful.

Mr. LILJEQVIST.—That is all, Mr. Mullen.

The WITNESS.—I may say that at the end of this street is a sheet asphalt street made directly afterwards that has never been touched, and under the same traffic as that section by the park where you see it all cut out for extensive repairs. The sheet asphalt pavement laid in 1916, a few years after, has never been repaired for maintenance work once, and is a perfect pavement to-day. [1070—513]

Testimony of John R. Heddle, for Defendant (Recalled).

JOHN R. HEDDLE, being recalled as a witness in behalf of the defendant herein, and having been previously sworn, testified as follows:

Direct Examination.

Q. (By Mr. LILJEQVIST.) Mr. Heddle, I forgot to ask you in reference to this report of the city of Hamilton published in 1902, which you have testified to, which has been offered in evidence, as to whether that report of the kind of a street laid there

(Testimony of John R. Heddle.)

was circulated throughout the country generally and if there was a great demand for copies of that report? A. Yes, there was.

Q. What happened in reference to that?

A. After our supply of these reports was exhausted the United States Consul—I think his name was Joseph D'Oliviers (?), had a copy made of that report in pamphlet form, which was distributed with a note—there was a note included by himself and distributed over the states, I think.

Q. Did you yourself supervise the laying of that identical kind of a pavement in any other city, at the request of any other city?

A. We sent a foreman to Oshkosh, Wisconsin, for two seasons.

That same class of pavement was laid there.

Q. And was that laid in the manner you have de-described? A. In the same manner, I believe.

Q. Do you remember what year that was?

A. No; it was between 1899 and 1902.

Q. You mean between nineteen hundred—

A. (Interrupting.) 1899 and 1902.

Q. All right; that is all. [1071—514]

Testimony of Kenneth S. Hall, for Defendant (Recalled).

KENNETH S. HALL was thereupon recalled as a witness in behalf of the defendant, and testified further as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

Mr. Hall in referring to the analysis of the Den-

(Testimony of Kenneth S. Hall.)

ver alley was referring to the pavement back of the McGovern undertaking establishment. Mr. Hall made an analysis of the portion of the pavement below the sheet asphalt top from the alley in the rear of the Denver Club marked Defendant's Exhibit "R." Thinks the analysis is on the sheet that was introduced, although he has not specifically stated it. An enlargement of the mineral aggregate in a sheet asphalt mix, multiplied by a constant figure, would bring it within the proportions of claim three of patent 727,505. Sheet asphalt mix is bitumen and sand that goes through a ten mesh screen; it is the maximum size particle that goes through a ten mesh screen. In taking this sample from McGovern's alley Mr. Hall and Mr. Liljeqvist were interrupted by traffic passing through the alley. Witness knows there were at least two large horse drawn vehicles that were carrying case goods and goods that were being delivered at the stores, in the rear of the stores. Doesn't remember just exactly what they were. Also some smaller vehicles, lighter vehicles. Those vehicles were going over part of that pavement, an exact sample of which has been brought into court marked Defendant's Exhibit "G." Defendant's Exhibit "R" is marked with Mr. Hall's designation "D. C." standing for "Denver Club." His analysis [1072—515] of that sample is as follows:

Retained on the ¼ inch.....51.4%
Passing the ¼ inch and retained on the 200 mesh.....44.9%

(Testimony of Kenneth S. Hall.)

Passing the 200 mesh screen..... 3.7%
Bitumen 4.0%

Mr. Hall has examined this specimen from Hiland Avenue that came with the deposition from Pittsburgh. Couldn't say for certain what the cementing material is; thinks it is tar from the odor of it. Witness hasn't seen much of it laid with tar. He understands from literature that some of it is good and some of it is bad. There is practically none used in this part of the country at this time.

Q. Will you tell the Court whether, if you took the proportions of material from one-half inch down to dust, as described in the state's specifications, or from three inches down to dust, as described in this patent, within the limits of one to three, ten to forty-nine, or ten to thirty, according to the preferred specifications, and coarser aggregate from fifty to eighty, made a homogeneous mass of that and cemented it with poor cementing material, whether that kind of a pavement would stand up?

A. It would be very doubtful if it would under any considerable traffic.

Witness has a photograph of the Warrenite plant, and in this plant the proportioning of the mix is done entirely by volume. In the standard plant it is done by weighing the materials which are segregated in the bins and weighed into the weighing-box. Witness then referred to a photograph, which was subsequently marked as Defendant's [1073—516] Exhibit "A–44," and stated the same shows a side elevation drawing of the paving plant used by the

(Testimony of Kenneth S. Hall.)

city of Portland. 31 represents the hopper or the bins which would contain the raw materials, that is, the materials not accurately proportioned. Those materials are introduced from there into the elevator at 34, carried by this elevator up into the drying drum, 17. That dry drum, on the lower end of that drum, furthest from the coal stone elevator, is a burner which burns oil and heats the mixture and drives off the moisture. That material passes through that drum, drops down to another elevator, which is also labeled "34," and from there the mixture, which contains sand and stone screenings in approximately proportions that the mix requires, from there it is carried up to the screens on the top of the plant. The screens are designated 35. Ordinarily there is a quarter inch screen in there. On the outside there will be a ten mesh screen—quarter inch material running in there, and quarter inch and the sand running through this first screen and dropping on the finer screen, the sand goes through the finer screen and the quarter inch will come out. Then there is a half inch and an inch and a half screen, and so it moves down into four different departments down there, so you have groups of sizes. Number one bin will have from impalpable powder to ten mesh, number two from ten mesh to quarter, number three from quarter to a half, and number four from an inch to an inch and a half. Then they are drawn through [1074—517] gates from the bottom of the bins into the weigh-box, which is represented by twelve, and then drawn out in the

(Testimony of Kenneth S. Hall.)

desired proportions; and from the weigh-boxes they are dropped into the pug mill, which is indicated by 11, which consists merely of a box with two shafts revolving in opposite directions with teeth on them, so that the mixture is agitated and thoroughly mixed; then when it is mixed it is dropped through a gate at the bottom of the mixer into the truck, which stands underneath the mixer, and is taken to the street. The bitumen tanks are represented by 30. The bitumen is heated in those tanks. It is pumped up through the pipe-line, which has no number. Number 15 witness believes is the bitumen pump. It is pumped up through this line, and it is also weighed out in a pug, and then it is poured into the pug-mill at the same time that the box is removed.

The photograph from which the witness testified was then offered and received in evidence and marked Defendant's Exhibit "A–44."

Witness then presents a picture, which was subsequently offered in evidence as Defendant's Exhibit "A–45," and stated it is a picture of the Warren Construction Company's plant at Forest Grove, which is now in operation, he believes, on some city work. Last year it laid about three miles or three miles and a half under state contract, practically the same specifications that were laid on the work in suit. On the left is a bunker into which the rock, the coarser material, is screened. These screens that they use are analogous to the screens on a crusher [1075—518] plant; their

(Testimony of Kenneth S. Hall.)

material, as witness remembers, came there rather badly mixed up, and these screens were put on to help them to segregate the sizes. Their rock from under these screens was drawn off into a hopper at the foot of this elevator and measured in volume. The elevator is shown on the left center. The desired volume of the rock was put into this hopper at the bottom, and the desired amount of sand was wheeled in by wheelbarrows from the pile in the right foreground. Witness believes there was two piles of sand, a coarse pile and a fine pile. Then when that batch which represented approximately three thousand pounds was properly proportioned, it was elevated to the hopper at the left end of the heating drum—the hopper holds exactly a batch—from there it is allowed to pass into the dryer and it is dried to dryness and heated to sufficient heat, and then is passed into the larger drum on the extreme right end of the plant. To it there is introduced the bitumen, which is weighed on the operator's platform at the foot of the stack. It is mixed in there until it is the proper consistency, proper homogeneity, and then it is dumped into the trucks, which stand under the right end of the mixer.

The photograph to which the witness referred is thereupon offered and received in evidence and marked Defendant's Exhibit "A–45."

Another photograph was referred to by witness, which he stated was a general view of the yard.

(Testimony of Kenneth S. Hall.)

This photograph was offered and received in evidence and marked Defendant's Exhibit "A–46." [1076—519]

Witness believes, in this contract of Oskar Huber's, the cementing material was furnished by the State Highway Commission, under its contract with Huber. Bitulithic cement was not used to his knowledge. The state got the cement from the Union Oil Company, he believes. What Mr. Hall got was grade D asphalt. It comes from California. It is the asphalt residuum from the California oils. He has no personal knowledge but believes it was not purchased from the Warren Brothers Company or the Warren Construction Company. They did not treat it or prepare it for use in any way, as far as witness knows. As far as witness' understanding, the State Highway Commission furnished it directly as it came from the oil company. He has no personal knowledge about it. Witness is handed a report and he states that it is the one he referred to as being one of Mr. Lazell's analyses which was missing. That is a part of the records in his office.

Said laboratory report was offered and received in evidence and marked Defendant's Exhibit "A–47."

Mr. Hall produces photographs taken of bitulithic streets, or streets laid under patent 727,505, in Portland. Witness is handed a photograph and states the designation of the street upon the back of it is correct. The board placed across the street

(Testimony of Kenneth S. Hall.)

is a straight-edge. It is a board of approximately three inches wide by about one inch thick, about twelve feet long. A straight-edge presumably means a perfectly straight edge. It was placed across this street and showed that this street was displaced by traffic. [1077—520]

Said photograph was offered and received in evidence and marked Defendant's Exhibit "A–48."

Witness is handed another photograph and he states that comes from approximately the same location as the other one; on the same street only two or three hundred feet away.

Said photograph was offered and received in evidence and marked Defendant's Exhibit "A–49."

Witness is handed a third photograph and states it shows the same condition on another street laid under this patent.

Said photograph was offered and received in evidence and marked Defendant's Exhibit "A–50."

Witness is handed another photograph and states it shows the movement under traffic on another street.

Said photograph was offered and received in evidence and marked Defendant's Exhibit "A–51."

Witness is handed still another photograph, and witness states it shows the rutting on a street laid under this patent.

Said photograph was offered and received in evidence and marked Defendant's Exhibit "A–52."

This condition, as shown by these five photographs offered in evidence, between the straight-

(Testimony of Kenneth S. Hall.)

edge, indicates a depression caused chiefly by traffic. That is, it is not displacement of the subgrade, although that might possibly have something to do with part of it. These photographs, witness thinks, were taken the 25th and 26th [1078—521] of May. Mr. Hall has made analyses of the materials that go to build up a pavement laid under the 1901 patent, for the purpose of showing what that wearing course contains when placed upon the sieve showing the gradations of the 1903 patent (grouping it under the claims of 1903). On a pavement laid under the 1901 patent, when the mineral aggregate is taken out and grouped under the claims of the 1903, they would fall within the claim three; witness wouldn't say offhand that they always would, but he would say they could be made to very readily.

Q. Now, Mr. Hall, with your knowledge of the paving business, can you tell the Court whether or not you can take patent 727,505, without any other information than is therein disclosed, and build the Oskar Huber pavement?

A. According to his claims, claim three would be the first one that I would look to, I believe, to get the grading of his aggregate that he figured on. Now, if I take that grading in claim three, I will find that without considerable experimenting that I can get all sorts of mixtures there. Some would be easy to lay and some would not be easy to lay on the street, but by experimenting no doubt I would find that there was a mixture in there that

(Testimony of Kenneth S. Hall.)

would lay very nicely. Well, then, I would look down to his next claim, in which he requires inherent stability. Well, now, inherent stability is a very indefinite thing, and when I see what he means by inherent stability I will have to go back into the specifications of his patent in which he gives a preferred claim. Now, in that preferred claim [1079—522] he says that he finds that by combining these materials that he can get the highest degree of stability, so I presume that he means by the grading that he gives in his preferred claims, that those are the ones to be used to get his inherent stability and his 21 per cent voids that he speaks of. Now, if I do that I am confined in my sand fraction to ten to thirty per cent, whereas in claim three he says ten to forty-nine. Well, if I stick to thirty per cent in my amount of sand, that is, material passing the quarter inch, my pavement does not agree with the pavement laid by Oskar Huber nor with the state's specifications, which calls for more sand than thirty per cent, so that I would, without further investigation or experience on the subject, I would be rather at a loss,—it would be more or less of a hit and miss proposition if I could lay that pavement as he had it.

Q. How about claims six and eleven—five, six and eleven, broad claims?

A. Well, five is the one I was speaking of, where he has several grades so graded as to give inherent stability,—that is, structural inherent stability. Well, that is rather indefinite. In his claim eleven

(Testimony of Kenneth S. Hall.)

he calls for 21 per cent voids. Well, the 21 per cent voids is very easy to hit, but when it comes to complying with his other claims I don't know. As I say, it strikes me it would be a very hit-and-miss proposition and one that requires a good deal of experimenting and practice.

Q. Now, Mr. Hall, did Mr. Mullen show you a street—did Mr. Mullen show you Sherbrooke Street, in the City of Montreal? [1080—523]

A. He did.

Q. Do you remember when you were at Montreal?

A. Some time in April; I don't remember the date.

Q. What year? A. This year.

Q. Will you state to the Court whether or not you observed that street as you went over it?

A. I did.

Q. Was it apparently a bitulithic street?

A. It was a coarse aggregate street.

Q. Now, exhibits have been offered in evidence—an exhibit has been offered in evidence, consisting of one—

Mr. LYMAN.—(Interrupting.) If your Honor please, may I interrupt? Are we to try that Montreal case again here?

Mr. LILJEQVIST.—No.

The COURT.—No, certainly not.

Q. (By Mr. LILJEQVIST.) Just one question on the thing. At that time, when you examined that street shown to you, did you see it in the con-

(Testimony of Kenneth S. Hall.)

dition or analogous condition to what is shown by these photographs marked Defendant's Exhibit "A–43"?

Mr. MONTAGUE.—The objection is sustained to this?

The COURT.—The objection is sustained.

Mr. LILJEQVIST.—Save an exception. I won't proceed any further after he answers this question.

A. Very much resembled that, yes, except this where it was cleaned out for repair, I didn't see that. [1081—524]

Q. Did that street as you saw it appear to have inherent stability, if you can define that term?

A. Well, I don't know; some of it did and some of it didn't.

From his knowledge of the laying of pavements Mr. Hall stated the sample marked Defendant's Exhibit "G" laid in the year 1892 and removed in the year 1922 and subjected to the traffic which he personally saw, certainly had a useful degree of stability.

Q. Do you know of any higher degree of stability that a pavement could have than having last thirty years subject to the kind of traffic you saw on it and similar to the kind of sample you brought into court?

A. I don't think it would need much more.

Witness stated the pavement laid in 1892 in the alley back of McGovern's, Defendant's Exhibit "K," which was subjected to the kind of traffic he personally saw going through that alley and was

(Testimony of Kenneth S. Hall.)

removed in the year 1909, must have had a useful degree of stability. Witness has testified as to the finer screen analysis of the Denver alley specimen which he took. Mr. Hall had a sample of the Hiland Avenue specimen, sawed and what counsel has is the sawed section.

Thereupon said sawed section of the Hiland Avenue sample was offered and received in evidence and marked Defendant's Exhibit "A–53."

Mr. Hall didn't make any analysis of this sample himself. It was made in the city of Portland, since it has been brought into court. With a set of specifications such as is attached to the contract entered into between the Highway Commission and Huber, it is impossible to lay [1082—525] the pavement absolutely to a stated percentage of the different proportions without varying. If a pavement is laid under a specification such as is attached to the state's contract and laid with the utmost care to attempt to comply with the specifications, the analyses of the different sections of the road would show an appreciable variance. As far as witness knows, there is no way to avoid that in the practical laying of the pavement under the specifications.

Cross-examination.

(By Mr. LYMAN.)

Mr. Hall came with the State Highway Commission in September, 1919. Has been with them ever since. His office is at Salem. His work is testing of materials and looking after paving mixtures and

(Testimony of Kenneth S. Hall.)

pavements. He has to do with the actual mixing of bituminous pavements and the mixing and laying of concrete pavements; not with the actual road work except in an advisory capacity, that is he has no authority. He was in the army prior to September, 1919. Witness is not familiar with the actual operation of the laying of this particular piece of work by Huber from which his samples were taken. He is quite familiar with the work after it was laid—that is, the operations of the laying during the year 1919. Mr. Hall is familiar with two other pieces of work put in by Huber in 1919 or early 1920, from Ashland to the Green Springs Mountain line, and what is called the Salem-Dallas road. They were laid under the same specifications as the pavement that was laid from the California line to Ashland. However, there were different materials used. There was no difference in the construction, that witness knows of, except the difference in materials. He would think his specimens would be [1083—526] fairly typical of all three of them. In making his analysis of the McGovern alley sample, Defendant's Exhibit "G," witness used the wearing surface, which is this material approximately three inches thick from the surface down. And he excluded the finer material at the base of the sample, because he considered it not part of the wearing surface. He couldn't say if it was laid at a different time from what they call the wearing surface on that sample. Witness made four analyses on that sample.

(Testimony of Kenneth S. Hall.)

Q. Was it—it wasn't this identical sample that is in court here, but a piece sawed off from that sample that you—

A. (Interrupting.) The same large sample.

Q. Tell us how you proceeded to get the parts that you used for making of those four analyses, please?

A. They were—as I remember, the piece that we used was a piece that was—we sawed the sample in half, then one-half we broke with a chisel and chiseled off a—I took a convenient size out of that and put it in a pan and warmed it, as I described before, so that the materials could be broken apart, and then there were four different samples taken out of that chunk.

Q. Well, you mean that four separate chunks were broken off?

A. No; no, there was just one chunk that would represent possibly one-quarter of the—or a little less than that, of the total sample that I took, the total sample that I cut from the street; then that was—there were four analyses made out of that. [1084—527]

Witness took four different samples before the bitumen had been extracted; from the warm material, as it was broken apart, he took out four thousand grams, and inasmuch as their extraction machine that he has will only hold a thousand grams conveniently, there were four different extractions made of it.

(Testimony of Kenneth S. Hall.)

Q. They all came from the immediate neighborhood of each other? A. Oh, yes.

Q. That is, they were all practically from the same spot? A. Oh, yes, this was the same.

Q. Practically from the same spot?

A. The same piece of pavement.

Q. No, but from the same spot in the piece of pavement.

A. Well, it wouldn't cover over a foot square on the pavement.

Q. Well, it would cover a piece at least as big as that. It might have been taken from anywhere. It is all stirred up, mixed up, so that the samples are taken hit and miss, wherever they would come, the idea being to get a fair sample. The samples he took for analysis were taken from a mingled mass, not from different parts of the sample. Witness also made an analysis of the sample which is said to have come from Vermont Avenue in Washington, Defendant's Exhibit "A–21." In making that analysis he used the portion just under the sheet asphalt, between that and the red sandstone base rock. He chose that, rather than the wearing surface of the sample, because he was led to believe, upon looking at it from the records, that the wearing surface had been laid on—had been resurfaced, and he wanted to get the original pavement. His theory was that the original pavement was that layer that lies between the asphalt wearing surface here, and the large stones of the base.

(Testimony of Kenneth S. Hall.)

It was on that theory that he analyzed just that small layer.

Q. Wasn't it pretty difficult to get enough of that layer to make a fair analysis? A. It was.

Q. You would have to do a good deal of scraping there, wouldn't you? A. Yes.

Some of the stones of the base appear to be right in that layer. Red stones where possible were excluded, where you could see them. but he didn't consider [1085—528] that part of the wearing surface of the original pavement.

Q. What kind of bitumen was there in that layer there that you analyzed.

A. I think that was tar. Yes.

By sheet asphalt pavement witness means a combination of asphalt and sand and dust, stone dust. Such as this upper layer on the sample, Defendant's Exhibit "A–21." What is meant by the term "sheet asphalt surface" depends on what part of the country you are in. He presumes in the early days they called this sample from Washington as asphalt pavement. In analyzing the sample marked Defendant's Exhibit "A–19" from Pennsylvania Avenue Mr. Hall took the top layer there of approximately an inch or an inch and a quarter, something like that; from the top. He was informed that that was the resurface that was put on there in the early nineties. For that reason, when he cut the sample he found it a coarse aggregate sample, he took the analysis of it. He would have also taken the analysis of the layer

(Testimony of Kenneth S. Hall.)

underneath that but he didn't have sufficient material; it would take too large an area to get sufficient material out of it to make the analysis. The immediate top of the sample has had a great deal of wear on it, there is no doubt of that, on account of the nature of the street in front of it. That street is subjected to a great deal of wear. He took this sample from the north side of Pennsylvania Avenue, between Twenty-fifth and Twenty-sixth Street northwest, approximately ten feet east of doorway number 2503, and fifteen feet from the curb. About a hundred or a hundred and twenty-five feet from Twenty-fifth Street. Doesn't remember exactly; it is somewhere around there. [1086—529] Witness has testified to making an analysis of two samples of pavement from South Omaha, one from a wall and the other from a dump. Mr. Hall didn't bring any other sample from South Omaha pavement; Mr. Beal had brought one when he came. He had nothing but the pieces that are left of those two samples exhibited in his office at Salem. In his analysis of Omaha sample marked "A–23" taken from the wall he included the top inch. He thinks the average of the bitumen was 1.4%. In Defendant's Exhibit "A–22," taken from the dump, the per cent of bitumen was 6.4 per cent. Asked how he accounted for the difference between the amount of bitumen in those two samples, supposedly from the same street, he stated he couldn't tell; he wasn't there when the pavement was laid. They were laid two years apart,

(Testimony of Kenneth S. Hall.)

the record shows. On his work sheet relating to the sample from the wall at Omaha the note which reads "number one and two are fine top, numbers three, four, five and six are layer top" means the coarser material. One and two, and three, four, five and six is purely laboratory stuff, just the number of samples; there were six analyses run on that one sample. Numbers one and two are the analyses run on that fine mixture top, and numbers three, four, five and six are run on the lower, coarser material. The analyses that he has here are simply of that three, four, five and six, or lower layer. The "W. M. S." on his reports is his operator down there at Salem. He made the analyses in Mr. Hall's presence. He signed them just as a matter of routine, as he makes out a slip. On specimen marked Defendant's Exhibit "H" Metropole Hotel [1087—530] sample, what he analyzed was the coarser material at the bottom; beginning three to three and a half inches from the top of the sample as it stands. The voids are determined mathematically on the pavement as is, that is, on the cut sample that is received from the street. The method of doing that is calculating the specific gravity of what your mixture should be in using the proportions that are obtained on the different screens in the screen analysis, and getting the specific gravities of the different sizes, including bitumen. The difference between the figured specific gravity of your mixture and the actual one found by physical determination by immersion in

(Testimony of Kenneth S. Hall.)

water, the difference between the two is the percentage of air voids, as they call them, or voids after compression. Those voids are voids that come from lack of compression; that is, they are included air. Then the percentage of voids in the mineral aggregate is merely figured by figuring out your bitumen and adding to that the percentage of air voids, and that will give you your total voids in your mineral aggregate, exclusive of your bitumen. The solvent he used for asphalt was benzol; on these samples that contained tar he used chloroform and carbon-bisulphide. As he remembers, the samples that contained tar were the DeSales and Vermont Avenue. Those are all, as he remembers. The part that he analyzed from Pennsylvania Avenue did not contain tar. Witness has seen what is called bitulithic pavement from almost Topeka up to solid rock. [1088—531] Asked which one of the samples introduced as evidence of prior art most nearly resembles Huber's pavement involved in this case, witness stated he believes that the Omaha sample from the wall possibly comes as close to it as any of them. He would think that is the closest, with the range of mineral aggregate.

Q. Why is that closer than the McGovern alley sample? A. There is more rock shown in it.

Q. More what? A. More rock shows in it.

Q. You mean by that that there is—that there are considerable spaces in the McGovern sample where there isn't any rock?

(Testimony of Kenneth S. Hall.)

A. There are spaces where the rock does not come to the surface, yes.

Q. Evidently a great many spaces where the rocks don't come in contact?

A. I presume so, yes.

Witness points out the sample taken from the wall at Omaha, and also Huber's sample. He testified that his analysis of the Omaha wall sample, omitted entirely the inch wearing surface of fine material; also that the part which he analyzed showed a bitumen content of 1.4 per cent. It was the sample which largely fell to pieces here a day or two ago. Asked if he attributed the fact that this sample has disintegrated so much since it has been in the courtroom to that small bitumen content witness stated that sample has been in that condition ever since he has had it. That has been standing wrong side up in a wall for a number of years, they tell witness, so that no doubt had a great deal to do with its condition. Witness knows nothing about the whole street being shattered. He knows that this sample was in the wall pretty well buried. [1089—532]

Q. Now, you think that that is the closest resemblance, because the stones in this lower part are more nearly in contact, more frequent, and come in contact with each other, more than they do in any of these other prior art cases?

A. I would think so—I would say that they do in this case, but this is gravel and that is crushed rock or crushed slag.

(Testimony of Kenneth S. Hall.)

The percentage of voids witness found in this sample from the Omaha wall was sixteen and twenty-five hundredths per cent. That was in the cone. In the pavement itself the witness thinks the amount of voids are greater than that, with the little amount of bitumen that there is in them. Witness thinks it was not a loosely laid mixture when it was laid. The other sample that was introduced here was the better example. He considers the two as being from the same pavement, and therefore in the same general class. Counsel refers to the quite wide variations in the amount of impalpable dust shown in Mr. Lazell's analysis of the Huber pavement and witness states they don't expect it to vary, not when the job is properly laid. There is not as wide a latitude in the specifications as some of the others. Thinks the specifications called for four to seven per cent. That means that there is a latitude allowed by these specifications of approximately a hundred per cent. The amount of [1090—533] dust that you need to get a good mixture depends somewhat upon the amount of asphalt that you put in, the quality of the asphalt. Witness considers it, as they are laying now, the work he is doing now, he considers that there is nothing hard and fast except the lower limit of it. He considers that you have got to set a definite lower limit, because your asphalt content can't drop down below a certain limit.

Q. Now, your analysis of the different samples cut from the Huber pavement differ somewhat from

(Testimony of Kenneth S. Hall.)

the analysis made by Messrs. Jenkins and Schutte. I will read for your comparison—for you—for your comparison—for you the comparison which I have compiled of the analyses made by you and them of the material in this Huber pavement which is greater than one quarter inch, that is, which is retained on the quarter inch screen. The average laboratory daily reports of Mr. Jenkins showed that amount to be 59.6 per cent; the average daily laboratory reports of the State Highway Commission, as made by Mr. Lazell, which were produced yesterday, showed that to be 54.4 per cent. The samples—the cut sample produced by—the two cut samples taken from this pavement by Mr. Jenkins and Mr. Schutte showed, respectively, 65.7 per cent and 63.9 per cent. Your samples—your first samples showed 50.3 per cent; your second sample, 49 per cent. The average of the three analyses in the government's files (sic) made by Mr. Lazell, among the papers produced yesterday, of the three samples cut by him an analysis showed 53.4 per cent, and the sample of the analysis which you have produced this morning, which was missing, made by Mr. Lazell, showed 50.1 per cent; in other words, those vary from approximately 50 per cent up to 65.7 per cent. Now, what is your explanation, if you have one, for the difference in these figures?

A. Well, it is impossible to get the same sample—the same analysis out of two samples, even cut from the same portion of [1091—534] the street.

Q. In making—you don't regard, then, those dif-

(Testimony of Kenneth S. Hall.)

ferences as of anything more—any greater moment than would naturally be expected?

A. Well, I assume that all the analyses are correct.

In witness' analysis he used a three mesh screen to determine the material above a quarter inch. A three mesh screen with the hole a quarter inch square. Mr. Hall hasn't such a screen with him. The hole is a quarter inch square; the diagonal of the hole is the square of the sum of the two sides. The diagonal of the holes in this three mesh screen would be about three-eighths of an inch. Witness presumes that is about what it would figure.

Q. And such a screen—stones up to three-eighths of an inch would go though such a screen as that?

A. Depending on the shape of the stone.

Q. Some stone would?

A. Yes, some stone, up to half an inch, would go through a quarter round, but if it is cut down at the end—

Q. (Interrupting.) Yes, it depends, of course, on how they happened to go. I am talking now about averages. I am pointing out that three mesh screen, you would naturally, as the criterion of what was and what was not quarter inch stone, you would get a less amount than if you used the regular four mesh screen?

A. You would get a greater—oh, retained amount?

Q. Yes, a less amount retained?

A. Yes, you are right, less amount retained.

(Testimony of Kenneth S. Hall.)

[1092—534 (a)] Witness doesn't know as there is any usual practice for determining what is a one-quarter inch stone. You speak of a quarter-inch stone, and a quarter-inch stone, he would say, would be one that would pass a quarter square.

Q. More properly, one that would go through a circular opening with one-quarter inch diameter, isn't it? A. Well, that is possibly true.

Q. To be strictly accurate? A. I presume so.

Q. At any rate, it is very common practice to use the four mesh screen to determine quarter inch stone?

A. It is with the Warren Brothers Company, yes. They are the only ones that I know of using it.

Q. But you notice that Mr. Mullen this morning —you found that all the results that he gave were determined on a four mesh screen, isn't that so? If you will look at that, you will find that that is so.

A. Well, the state, ever since I have been with them, have used the three mesh, and that is what we grade our mixtures on.

Q. Well, however that may be, that difference— I don't think it is of any consequence in the case, your Honor, except that that difference between your three mesh screen and the four mesh screen, which some of these other gentlemen have used, would explain,—would very likely explain any difference between the figures that your analyses show as to the material graded on a quarter inch and the figures that they show.

(Testimony of Joseph L. Hammersly.)

A. It would tend to make a difference, no doubt. [1093—535]

Testimony of Joseph L. Hammersly, for Defendant.

JOSEPH L. HAMMERSLY was thereupon produced as a witness on behalf of the defendant herein, and, having been sworn, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

Joseph L. Hammersly testified he was deputy district attorney for Multnomah County; he has held that position going on ten years. Witness knows of samples being taken out of the Columbia River Highway in his presence. They were taken at three different points, if his recollection serves him right. Thinks it was in 1916. Would have to refresh his recollection on that. Between the bridge opposite the Automobile Club grounds and Chanticleer Inn. That is, he thinks it was about three miles east of the bridge that crosses the Sandy River, at the Automobile grounds. He knows there were three samples; there may have been more. Witness can't say whether the samples were delivered in his presence to Mr. Dulin, but they were brought to the grand jury room, and witness was in charge of the grand jury. They were brought in, he thinks, in the car that he was in, and then they delegated three of the grand jury to take these samples, and witness has forgotten just where they took them, but Mr. Dulin, he knows, was interested some way or other, and tests were made.

(Testimony of Joseph L. Hammersly.)

Three members of the grand jury were designated to take the samples to three different chemists. Mr. Dulin was one of the chemists. [1094—536]

Cross-examination.

(By Mr. LYMAN.)

Investigation was had because complaint was made that the work was not being done according to specifications. Several complaints came to his office, and it was charged that the different portions along the roadbed—that is, an inferior mixture was being put in. The complaint first originated, he believes, out at some grange located in the Lents District. They thought it was a proper matter to call to the attention of the grand jury, and witness doesn't know how many witnesses were subpoenaed in, but a great number of them. A great number of witnesses were brought in.

Mr. LILJEQVIST.—This was not offered for the purpose of showing anything else except to connect up a sample taken out of the pavement and then analyzed to see what the analysis was. I don't care about the history. We are not jumping onto anybody by saying what occurred there or what did not occur there; simply showing that a sample was taken out of that, and we are going to introduce a test.

As a result of that investigation everything was found to be all right and there was no criticism of anybody.

Testimony of Kenneth S. Hall, for Defendant (Recalled—Cross-examination).

KENNETH S. HALL thereupon resumed the witness-stand and testified further as follows:

Cross-examination (Contd.).

(By Mr. LYMAN.)

The pavement that he testified as being recently laid for the purposes of this case was laid on the Columbia River Highway, between Mosier and Rowena; approximately seventy-five miles from here. There is a paving job in operation at the present time. The rest of the job is laid under state specifications, asphaltic concrete; that is to say, what is called in this case, at any rate, bitulithic. The pavement laid in accordance with the specifications in the Pace case was laid between stations [1095—537] 269 plus 87 and 271 plus 13. That is 126 feet of pavement. The specifications laid under Warren's letters patent 675,430 (1901 patent) was laid between station 271 plus 13 and 272 plus 31.5. That is 118½ feet. Then the Filbertine pavement in the Evans case was laid between stations 272 plus 31.5 and 273 plus 30.5—ninety-nine feet. Under the Averell patent, laid station 273 plus 30.5 to 273 plus 75.5—47 feet. When he says that a piece of pavement was laid under the 1901 patent he means it was endeavored to apportion the mixture to comply with the grade as he would cover in this 1901 patent. He gave yesterday the proportions of the material which he used there. He

(Testimony of Kenneth S. Hall.)

believes that patent calls for a specially prepared foundation; it says on a prepared foundation.

Q. Prepared foundation, and it describes the foundation as consisting of stones of from three to six inches, as I remember it, projecting up into the wearing surface; isn't that so?

Mr. LILJEQVIST.—I don't think so.

A. I don't believe his last claim is that way. The first claim, that it could be used on a prepared foundation and as a binder.

Witness points out the pavement laid under the 1901 patent. That material was laid on a regular bituminous base; crushed rock, bitumen and sand and dust. In making this mixture which was laid inside the Pace specifications, as exemplified by Defendant's Exhibit "A–30," he endeavored to follow the specifications which were given in the Pace case, which are specified from one and a quarter inch to one quarter, 40 per cent, sand 53 per cent, stone dust, 7 per cent.

The COURT.—(Interrupting.) Half of that pavement, then, is sand. A. Yes, sir.

Mr. LYMAN.—That didn't give you much keying effect between the stones, did it? A. No, sir.

The COURT.—And what did you include in sand? What do you mean by sand?

A. I took it to—in the ten mesh down is the way that the plant screened it out.

The COURT.—You took all below the ten mesh for sand? A. Yes, sir.

Then the witness [1096—538] indicated a

(Testimony of Kenneth S. Hall.)

sample heretofore introduced into evidence as being laid under the Evans specifications. That was following the specifications given in the Evans case, which called for three-quarter inch stone, from fifty-five to sixty per cent.

The COURT.—That is, stone that passed through a three quarter mesh?

A. I believe in that case the decision was—the Court held that a three-quarter inch stone was one passing the three-quarter and retained on the half, so that it was practically a one-size stone.

Witness stated it was almost impossible to use a one sized stone in this material because the plant had been running all the time, and naturally, with the scrapers running over it would include some of the larger rock. The way he did it was to feed nothing but screenings to the plant, aside from plant in the rock class—nothing but screenings, and then allow those screenings to go into the rock bins, so that he got only the largest of the screenings, but there was some of the larger rock included in there.

Q. Well, then, you haven't got an example of what was held by the Court in the Evans case not to be an infringement, in that you have not got a uniform size stone?

A. Not absolutely, no; I will—

Q. (Interrupting.) Well, I say, a very large—go ahead.

A. I will admit that that one attempt was not as successful as it might have been.

(Testimony of Kenneth S. Hall.)

Witness made something under the Averell patent. The Averell patent is for a conduit, which can be used for a street surface, also, which he mentioned. Witness points out his pavement laid under the Averell patent and being asked if that would be suitable material in which [1097—539] to imbed tubes containing electric wires for a conduit, witness stated he didn't know; he was not an electrician. In going to work to lay this material under the Averell patent, he took a gravel that he proposed to use and determined the voids on it by putting it in a container of known volume and then adding water, so that it measured the amount of water that he put in. The gravel that he proposed to use was gravel no larger than a pigeon egg, called for in the patent. He didn't use one uniform size of gravel but used a graded gravel, starting with a pigeon's egg and running all the way down to dust, whatever there would be in it. That was witness' understanding of what the patent called for. He has the analysis of the plant sample and the cut sample. By plant sample he means the mix as it came from the mixer, and that analysis is as follows: Between the inch and a half and the one-quarter, 46.9; one quarter to two hundred, forty-six one; passing two hundred, 7 per cent; A. C. asphalt, 5.7 per cent. The analysis of this cut sample is, between the inch and a half and quarter, 55.8 per cent; between the quarter and the two hundred, thirty-seven and seven; passing the two hundred, 6.5 per cent; bitumen, 6.3 per cent.

(Testimony of Kenneth S. Hall.)

Asked why there is such a variance between the two samples Mr. Hall stated it is rather hard to take a representative sample at the plant—one plant sample amounts to very little. You should take several of them in combination, and you can see how your work is running, wheheas just one sample is something very misleading. In making the Averell sample he got the gravel from a pit about seven miles from the plant. He asked them to haul it in there especially, one night, [1098—540] from the pit. They didn't screen before they put it in, they used the screens in the plant. It was rather fine gravel. There was practically none in over an inch and a half. They put it all right in as it came from the gravel pit. They didn't do any screening before it came to the screens on the plant. Asked how he determined what was to go into this Averell mixture, he stated he had forgotten part of his procedure. He had screened it out at the pit, and made several analyses wih his plant inspector. They went to the pit and screened the gravel out—what he means is, made a chemical analysis, then he tried to duplicate in the plant, knowing the way the screens screened in the different combinations, he tried to reproduce the same gravel—it was a pit-run gravel—and put it into the pavement. That was his attempt. That is, he was trying to get the pit-run gravel. He rather interpreted Averell's patent as meaning, when he said "gravel no larger than a pigeon's egg," why, he would go out to a gravel pit and use that gravel.

(Testimony of Kenneth S. Hall.)

Witness had no inch and a quarter screen, so he had to rely on the inch and a half screen that was in the plant, and there was very little gravel in that that had particles as large as an inch and a half. He then proceeded to determine voids; he used enough sand to fill the voids in the gravel. He first took that mixture of gravel that he was going to use and by that water test that he has spoken of, determined how many voids there were in that mixture. He found thirty-five per cent of voids. Then he added approximately thirty-five per cent of sand; by weight. Then he ran another test and found 17 per cent [1099—541] of voids. He mixed the sand with the gravel and ran the voids through the water on that. That determined his mix on it. From that he figured the weight that he would need to get that mixture from the plant after it had been screened in separate bins. The bitumen, according to the specifications, was to fill the voids, allowing for shrinking. He figured that that would take around seven per cent. He used a little less bitumen that that, because this was to be used on a grade in their pavement, and he didn't want to take any chance of it being too "soupy," as they call it. Mr. Hall put dust in the mixture also; the patent speaks of five to ten per cent dust. Witness didn't put the dust in before he made the void test because, as he remembers, Averell says afterwards that he puts that in, after he makes the void test. Asked to describe this void test made by water, Mr. Hall stated he would fill up the con-

(Testimony of Kenneth S. Hall.)

tainer with the compacted gravel, and then add water to it until the water came to the surface of the material that was in the container. Of course, knowing the volume of the material in the container, and then the volume of the water that it took to fill. He had no difficulty in making the water penetrate into the mixture. This is the only pavement that they laid under the Averell patent. He didn't try any other mixture at all. He didn't try a mixture in which you used just stone, sharply screened stones of the pigeon's egg size, and then sand and then dust. Asked what result he would expect to find if he did try that he stated you would get a great many stones with the voids practically filled with sand. In fact, your voids would [1100—542] be filled and your stone would be touching. Going to the McGovern alley and the amount of traffic there, witness stated he saw two heavy teams, several light delivery wagons and frequent light delivery trucks while he was there. He spent probably in all at least an hour, and he visited it at two or three other times from the time he got the sample. Traffic, such as it is; a great deal of it is very heavy. It is iron-tired traffic, mostly.

Q. Naturally, it is rather infrequent traffic in the alley?

A. It would not be like a main thoroughfare, no.

Witness thinks there would be less wear in the alley than there would be in the main thoroughfare excepting that the traffic all runs in two ruts as a rule. In reference to the sample produced here

(Testimony of Kenneth S. Hall.)

there were no ruts; the sample was in the path of traffic. One of those places of the path of traffic might very well be at the point where the sample was taken. Witness thinks the sample was taken six feet from the wall. The alley was sixteen feet wide from wall to wall. The piece of pavement went eight feet, just half; the entire valley is sixteen feet.

At the request of counsel for complainant the work sheets of Mr. Hall were marked for identification as Plaintiff's Exhibit 39.

The samples of pavement laid between Mosier and Rowena that Mr. Hall testified to were laid May 2, 1922. Referring to these photographs of bitulithic pavement which witness has produced, they were taken in different neighborhoods. One is out in the Mt. Tabor district and [1101—543] the other is this side of Rowena Park. There were five in each one of those places, he believes. Asked the purpose for which he has produced these photographs, he states he thinks that those show that whatever inherent stability they may have independent of the cementing medium doesn't do them much good.

Q. Well, do you mean— is your effort in producing those to show that the bitulithic pavements as laid in this town haven't been a success, is that what you were trying to prove? A. Oh, no.

Q. You wouldn't say that?

A. I wouldn't say that they haven't been very good bitulithic pavements.

(Testimony of Kenneth S. Hall.)

Q. As a matter of fact, you know perfectly well, do you not, that they have been a very great success?

A. I know they have been in for a number of years.

Q. You know, as a matter of fact, that there is no denying that the bitulithic and Warrenite in this town and on the Columbia River Highway and everywhere else has been on the whole a very great success; isn't that a fair statement?

A. It has given very good service.

Q. Now, it is possible for you, of course, to find individual instances where they may have been rutted, or something naturally, and that is what these two photographs that you have shown show?

A. Yes, they show that. [1102—544]

Witness thinks there was no rutting on the street in front of his office down at Salem. That pavement has had a reflush coating. Don't know when it was laid nor whether it is a bitulithic pavement. He has only been there two years and a half.

Q. You had some hesitation in answering questions of the Attorney General as to whether it would be practicable to go on laying indefinitely the pavements which you laid as illustrating what your understanding about the Warren patent of 1901, 475,-130, whatever it is. What is the fact, would you care to lay such a pavement indefinitely?

A. No, I wouldn't care to lay it.

Q. Why not?

(Testimony of Kenneth S. Hall.)

A. Because the pavement won't close up on top, too open.

Q. Then there is at least some difference, even in your judgment, in that pavement and the pavement covered by the patent in suit, isn't there?

A. Yes, it depends upon the bitulithic laid in the patent in suit, but you can lay a pavement just the same.

The COURT.—Get the sample of the first Warren patent.

(Thereupon, the witness produces a sample of pavement and indicates its formation to the Court.)

A. Yes, you see the surface is very rough, the voids are not filled.

Q. (By Mr. LYMAN.) It has a larger portion of coarse material and a less proportion of fine material, has it? A. Yes.

Mr. LYMAN.—You heard his last answer, a larger proportion of coarse and a less proportion of fine material used?

The COURT.—Yes.

Thinks he is correct in his statement that in practically none of the heavy traffic pavements in Portland, bitulithic pavements, he could see the Mosaic effect, because the flush coat, repeated flush coat built up some. Fifth Street, as he remembers it, has been cut and possibly resurfaced and changed, so that to [1103—544(a)] him it is rather hard to distinguish which is the original and which is not. Frankly, he hasn't noticed that

(Testimony of Kenneth S. Hall.)

section. Sixth or Seventh, one of them, doesn't look like the original to witness, it looks like a repair. The original between blocks on Yamhill, however, is very thickly covered with a fine mixture.

Redirect Examination.

(By Mr. LILJEQVIST.)

Referring to the Green Springs Mountain pavement laid by Oskar Huber, starting in 1920 season, witness believes, all that pavement subsequently laid on that section was laid of two layers—the foundation and the wearing course. On the pavement laid in 1919 before May 5th, 1920, the contractor laid a crushed stone base and a two inch wearing surface on that. He would call it a bituminous concrete on a crushed stone base; that is the way they designate it. No bitumen sprinkled in the base. In 1920 it was a regular plant mixed base, and he doesn't remember whether that was three inches over the whole job. Their usual construction was three inch bituminous concrete base with a two inch wearing surface. They did over a considerable portion of that pavement, he thinks possibly two miles, or something like that. That was done before the contract was completed and accepted. He thinks they sublet it. There was no trouble in the mixture. They had trouble with the foundation part of the pavement. Before the contract was accepted and completed, on that portion of the Oskar Huber Green Springs Mountain Road laid prior to May 5th, 1920, which consisted of

(Testimony of Kenneth S. Hall.)

a crushed rock base and a wearing top, they went back before the contract was completed and laid another wearing surface over a portion of it. They had over that portion three layers, the base, a layer of asphaltic concrete and another layer of [1104—545] asphaltic concrete. He has a compilation of the stations. In 1919 they laid 49,220.9 square yards—that is the total that was laid in 1919. Resurfaced in 1920 and '21, 19,890.3 yards, leaving a total of the 1919 top which is now in use as a wearing surface of 29,330.6 square yards. The stations laid in 1919 were from stations 0+00 to 98+75, and stations 129+96 to 189+48, and 430+60, and 546+34. Of this work stations 430+60 to 446+34, with the exception of station 511+05 and 510+10 were resurfaced in 1920 and '21. That is as he makes it from the Street Inspector's report. There are a hundred feet in a station. Oskar Huber laid under the same specifications about eight or nine miles (possibly more) of pavement using gravel instead of crushed rock. Counsel hands witness a sample of the gravel pavement and Mr. Hall states he thinks that is a fair sample of it. This pavement was laid under the same specifications as the crushed rock pavements. The wearing surface of this sample is two inches from the top down, approximately; it should be two inches. He would say a point approximately two and a quarter inches down is where the top of the pavement is shown. The top he refers to is where the figures 678 are. That sample was taken from station 678 on the

(Testimony of Kenneth S. Hall.)

Green Springs Mountain Road, California line section of the Pacific Highway. Laid by Huber under the same contract; laid in 1920 subsequent to May 5th, 1920, under the same contract, which was entered into before May, 1920. Part of the highway on which the complainants in this case are claiming that Oskar Huber should pay royalty. From an inspection of this sample laid [1105—546] under the specifications, the gravel are not all in contact; there is the surface. Witness believes Oskar Huber laid some with gravel before May 5th. Thinks this is a fair sample of the gravel pavement laid before May 6th or after May 5th.

Thereupon the specimen above referred to was offered and received in evidence and marked Defendant's Exhibit "A–54."

In making his analysis of the sample of the Averell pavement after it was mixed and actually became a part of the pavement, he did not use any water in that kind af analysis. He has used the truncated cone in making some tests. In his judgment, there is a material difference in the result arrived at for the purpose of determining voids by the use of the truncated cone and the method that he has described. The cone will no doubt give you a lower voidage and, as Mr. Schutte says, more concordant results. On some of these samples he has already testified as having analyzed, the voidage was made on the cone system and some on the other. Asked to state in what samples he made

(Testimony of Kenneth S. Hall.)

the analysis by cone tests, he stated he made one on this Omaha sample from the wall, and he believes on the DeSales Street sample and from the sample from Vermont Avenue, the intermediate course on that. Thinks those were all. A square hole having quarter inch sides will pass more material and therefore have less retained on it than a round hole having a quarter inch diameter. To determine the extent of the difference of the aggregate retained on the round hole and your square mesh you would have to figure the area of your quarter inch square and the quarter inch round. More aggregate would be [1106—547] retained on the quarter-inch round aperture than on the quarter-inch square aperture; so in making the tests which witness has described, if he had used the round aperture instead of the square aperture, the material shown remaining on the quarter-inch round aperture would be slightly higher. Witness would hardly attempt to tell approximately what per cent it would amount to but he knows in some cases it probably would have made some considerable difference because in certain mixtures that size in there is quite a critical size, there is a good deal of material just about that size between a quarter and three-eighths, so some samples if you use the round screen and possibly other samples would probably not make very much difference. Witness' test of material that would pass a screen with a square mesh with the diameter of quarter inch and that retained on the 200 mesh would be larger than Schutte's result where he used

(Testimony of Kenneth S. Hall.)

the round aperture. Witness cannot tell what the percentage of difference would be. He could tell if the material were graded, screened close enough so that he could tell where those passing an inch square would stop. Witness finds nothing in the patent which says you must use a round hole with quarter inch mesh. He would not say that the Warren people are the only people using the round hole. The state has always used the quarter inch square since he has been with them and Mr. Lazell used it. It is a standard mesh. He thinks it is a mesh in common use by chemists or persons who make analyses of rock mixtures. Asked to state why he didn't know the street in front of his office was bitulithic, Mr. Hall stated he took particular note of that street last Sunday as he was turning around, driving away from the office, and he noticed that it had what he referred to in his former testimony the other day, it had [1107—548] a very thin coat of protective, a coat of sheet asphalt, whatever you might call it, on top of it. The day was warm and the automobile tracks were in it. His office is in Salem; it is above the State House, across from the Supreme Court Building. The south side of State Street, east of Twelfth. What he means by thin coating of sheet asphalt is what he testified about the other day of flush coat put on and sand sprinkled on there; he didn't mean to leave the impression that it is resurfacing. Couldn't tell how thick it is, but it isn't over a quarter of an inch. In this gravel for the Averell

(Testimony of Kenneth S. Hall.)

patent he went to the pit first. And at the pit he made a mechanical analysis, or screen test, on the material. He tried to get a representative sample of the pit-run as it would be taken to the plant. Of that particular pit. For the purpose of making that test to determine what would go into his final pavement, he took from inch and a half down to ten mesh; that he believes is the way he took his gravel. The analysis he made at the plant where they had their screens. He used the water for determining the voids. He dumped out the gravel and mixed it with the sand and put it back in the container, and put in water again, and determined how much voidage there was then in that sand and gravel. He found that to be seventeen per cent. He did that for the purpose of determining how much gravel was used and how much sand. He presumes it was fresh water gravel, it was in the pit possibly seven hundred feet above the Columbia River, so he imagines it would be fresh water. It was pit-run gravel. He thinks the gravel was laid there by water once [1108—549] upon a time. He made that test of this material by using hand sieves. His small size on a 10 mesh. From the plant, of course, he took everything that came through; everything that he could take and still not spoil his proportions, approximating his pit run. Asked how he separated between the sand, what would go 10 mesh and above the 10 mesh, he stated that all run into a bin, that goes into the No. 1 bin passing the 10 mesh, then he took enough out of the material

(Testimony of Kenneth S. Hall.)

from the other bin to make up to approximate his gravel as he found it. The gravel went into three bins. One bin is from inch and a half to a half, the other is from a half to a quarter, from a quarter to a tenth. The No. 1 bin, as they call it, comes out first, is from 10 mesh down. Then he endeavors to draw enough from each one of those bins, enough so as to recombine them in the same proportions that he had in the first place. In other words, to produce this pavement as he tried to do it, it would have been better to have a volume plant because then he could have taken the sand in a certain volume and gravel in a certain volume, but this way he had to combine the sand and gravel from a pit run. He put into that batch the 35 per cent of sand. He had gravel from 10 mesh up to what would pass inch and a half screen. He put into that 35 per cent of sand from the 10 mesh down. He has forgotten how much dust he added, from five to 10 per cent; that varies because there is a certain amount of dust in No. 1 bin comes from your sand and a certain amount of dust that we add to mix it. He added about 20 pounds, which when finally analyzed was about 7 per cent. Then he run that through the mixer and placed [1109—550] it upon the street, and rolled it and after it was rolled the sample was cut and analyzed. Asked if being on the hill had anything to do with the mineral aggregate, he stated if you get too much mortar or too much bitumen, naturally there is too much material in between the larger particles, your density

(Testimony of Kenneth S. Hall.)

is decreased, it pries your particles apart. He thinks he put about 68 pounds of bitumen to the 1000 pounds, that would be about six and a half per cent. He found 35 per cent of voids in the gravel. Seventeen per cent voids after he mixed his gravel and sand. He didn't put in 17 per cent of bitulithic cement. If he had put all that cement in it, it would have flowed off the road, you couldn't have held it on the road. If he had put 17 per cent of bitulithic cement or any other kind of cement into this pavement laid by Oskar Huber, the same thing would happen to it, you would not be able to even roll it, he imagines.

Q. Well, the voidage in the rock of 17 per cent, the rock, sand and dust, 17 per cent, how would that—how do you figure the percentage of cement, by weight or volume that would fill that voidage?

A. Well, I figured that—I took, for the sake of argument, that the mixture I had had a specific gravity, say around 2.5, I believe is what I took, and bitumen, roughly, has, or asphalt has, gravel has one. Now, in order to—the voids, the 17 per cent of voids are on a solid, you might say, has a gravity of 2.5; therefore we find the weight of a medium whose gravity is one; you divide your 17 by 2.5, which would give approximately 6 per cent. [1110—551]

The amount of asphalt that he put into this Averell mix, he put in possibly a little less than is called for by this patent, substantially the same. It would be substantially the same, it is possibly

(Testimony of Kenneth S. Hall.)

a little less, if anything. He could lay a pavement under the 1901 patent. From the fact that the limits are very narrow, it would confine his being very careful in his grading. It has a very material bearing upon the question of expense.

Q. (By Mr. LILJEQVIST.) Well, from the standpoint of practicability or possibility, what is the fact whether or not you can lay a pavement under the 1901 patent?

A. Well, the 1901, as I think I stated before, not only are the limits very narrow, but it would be very hard in any locality to find conditions, to get material, economically get material that would apply to those specifications. The crusher runs would have something to do with the difficulty of crushing the materials to fit the 1901 patent; some crushers produce a great deal of fine and others do not. Under the 1903 patent you can use the whole product of the crusher run, but under the 1901 patent, he rather doubts, except under exceptional conditions, that you could use it to comply with the claim. You can't use crusher rock in Topeka mix. In the Topeka mix you have got to select your material more carefully. Witness made a void test in the Topeka mix; has testified to that.

Recross-examination.

(By Mr. LYMAN.)

In determining the voidage of the gravel for his so-called Averell experiment, Hall cut out everything below the ten mesh. He differentiated gravel as being above the ten mesh and sand below the

(Testimony of Kenneth S. Hall.)

ten mesh on account of the screen at the plant, because that is the way he had [1111—552] to draw his bins to recombine it. In making the original water void tests he excluded the material that came from the pit that was below the ten mesh because when he recombined them he would have three bins, the gravel, the rock and No. 1 bin would be the same.

Q. (Interrupting.) In making the tests for your voids that you tell about there, why didn't you leave in the material below 10 mesh?

A. Well, that is sand.

Q. That is where you draw the line between gravel and sand?

A. That is the way you do in the paving plant, yes.

Further Redirect Examination.

(By Mr. LILJEQVIST.)

Q. If you had used everything from this inch and a half down to the finest that is found in your gravel pit, poured it into the container for the purpose of determining the voids in it without screening out his ten mesh sand, what would it have meant with reference to the amount of sand that would have to go into it as shown by the water test—I mean would it take more sand or less sand?

A. It would take less sand.

Witness hardly thinks there would be any difference in his result, it would just mean subtracting sand in one case and adding it on in another, in the other case putting it all in one.

Testimony of Samuel H. Probert, for Defendant.

SAMUEL H. PROBERT was thereupon called as a witness on behalf of defendant, and being first sworn, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

Samuel H. Probert testified that he is a civil engineer; is employed by the State Highway Department. Counsel refers to a report which was referred to in the [1112—553] opening part of this case as showing the amount of yardage laid by Oskar Huber prior to May 5th, 1920, and witness states he has a record of it but cannot produce it there. Neither the Highway Commission nor any other person gave witness authority in any tabulation that he prepared of the amount of yardage to state that the State was liable for a royalty on any specific quantity or number of yards. The State or Highway Commission furnished the contractor with the asphalt used on these jobs. The asphalt came from California. No portion was purchased from Warren Construction Company or Warren Brothers Company. None of the asphalt used by the State was refined by the Warren Construction Company or Warren Brothers Company, or inspected by them or labeled by them, that witness knows of.

The yardage of pavements laid by Oskar Huber under the contracts involved in this suit, prior to May 5, 1920, were as follows: upon the Green

(Testimony of Samuel H. Probert.)

Springs Mountain Road to the California line section was 49,230.2 square yards, and on the Ashland Green Springs Mountain Road section 7,795.5 square yards; on the Salem-Dallas section 17,516.1 square yards. These are the roads referred to in the contracts in which the Highway Commission instructed the contractor not to consider any royalty.

Mr. LILJEQVIST.—Now, I understand you don't claim anything in this case other than those contracts, do you?

Mr. LYMAN.—No, that is the only thing, the ones laid by Huber, on which he has not paid or is not under obligations to pay, under direct obligation to us by contract, to pay royalties.

Mr. LILJEQVIST.—In other words, there is not involved in this suit any contracts which he made in prior years wherein [1113—554] he himself assumed to pay royalties?

Mr. LYMAN.—Oh, no, I think they have either all been paid or else they are to be paid by virtue of direct contract. They have practically all been paid, I understand, except some slight amounts.

Cross-examination.

(By Mr. LYMAN.)

Q. Mr. Probert, was this paper from which you have testified compiled by you?

A. By myself and assistants.

Q. The heading of this: "Statement of amounts of bitulithic pavement laid on various jobs during 1919 and 1920, to midnight May 4th, 1920. This

(Testimony of Samuel H. Probert.)

table only includes those jobs in which the State of Oregon will be primarily responsible for the payment of royalties in case Warren Brothers patents on bitulithic pavements are declared valid."

Q. Now, I notice that in the notes appended to this list and the list includes other contractors besides Huber, that in some cases there is a note that money is being retained by the state and the state will be entitled to retain it in case patents are declared invalid. Does that mean that the State has held up part of the pay to the contractors to be applied against royalties if the State has to pay the royalties?

A. I think that would be true in one instance in accordance with the terms of the contract. [1114—555]

Q. Do you know whether—when these bids were being received for this work under which the State was contracting to indemnify the contractor from any royalties that might be assessed against him, that liability was taken into account by the State Highway Commission in balancing one bid against another, that is, did they include—did they add to a bid for this type of pavement an amount on account of the royalty that it might be liable for and for the purpose of comparing that bid against a bid for some other kind of pavement?

A. I don't know.

Mr. Probert stated his connection with the State Highway Commission is office engineer. These records were made up under his direction. Asked the question if he has knowledge from his official

(Testimony of Samuel H. Probert.)

capacity as to the matter to which counsel has inquired, witness stated in a general way. He can't say positively with reference to those two Huber contracts. As to the other contracts in some instances that was taken into consideration. He can't say whether it was in the Huber contract or not. Thinks it was the general practice to take that into account for about two lettings, probably applied to four or five jobs.

Redirect Examination.

(By Mr. LILJEQVIST.)

There were at least two jobs, there may have been more, he wouldn't say positively about that. The Warren Construction Company was one of those.

Adjournment. [1115—556]

June 2, 1922.

Trial resumed.

Testimony of J. M. Head for Defendant.

J. M. HEAD, one of the attorneys for complainant, was thereupon called as a witness on behalf of defendant, and being first sworn, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

Q. Are you an officer of the complainant in this case? A. I am not.

Q. Did you conduct on behalf of Warren Brothers Company the suit in the District Court of the United States for the Southern District of Cali-

(Testimony of J. M. Head.)

fornia, Southern Division, wherein Warren Brothers Company was cmplainant and C. M. Thompson and others were defendant?

A. I assisted in the trial of the case.

Q. Did you file on behalf—did the Warren Brothers Company in that case, for the purpose of showing the issues and intentions in that case, file an affidavit of one Edwin C. Wallace in that suit? I hand you a certified copy to refresh your memory if you desire it. A. They did.

Mr. LILJEQVIST.—Now, we offer in evidence, may it please the Court, for the purpose of showing the inconsistent positions of the complainant, its interpretations and claims in the patent under suit, that part of the affidavit of said Edwin C. Wallace, wherein he states as follows, quote—

Mr. LYMAN.—(Interrupting.) Well, now, just a moment; I don't know what the affidavit is, but I can't see how it has any possible relevancy with reference to this case.

The COURT.—Is that the one you offered the other day? [1116—557]

Mr. LILJEQVIST.—No, I interrogated Mr. George C. Warren about it and asked him if he agreed with those statements, and one he agreed substantially and some in part, and this is shown in the affidavit filed by the complainant itself, and it seems to me it certainly is evidence showing its position when it filed this affidavit with reference to interpreting this identical patent.

Mr. LYMAN.—Interpreting this identical patent?

Mr. LILJEQVIST.—Yes, sir, and this is offered for the purpose of showing what inconsistent contentions were made by the Warren Brothers Company in reference to the patent in suit.

Quote—

Mr. LYMAN.—(Interrupting.) Now, just a moment, let his Honor rule on that.

The COURT.—I don't think it could possibly be competent in this case, no matter what inconsistencies there may be in other cases.

Mr. LILJEQVIST.—Well, their own interpretation of their own patent, and the evidence shows that they filed this themselves voluntarily.

The COURT.—Well, you can put it in the record, but I don't see what bearing it has in this case.

Mr. LILJEQVIST.—I can shorten it up. Commencing with the word "prior" in the third paragraph on page 14, ending with the words "mixture table" on the end of the second paragraph at page 15; commencing with the words, "Warren's idea," the beginning of the third paragraph on page 17, ending with the words, "Warren patent," at the end of the third paragraph [1117—558] on page 17; commencing with the word "Warren," beginning at the second paragraph on page 18, ending with the words "nicety of decision" at the end of the second paragraph on page 21. Commencing with the words, "Warren found," beginning on the second paragraph on page 22, and ending with the word "retained" at the end of the first paragraph of page 23.

Mr. LYMAN.—Now, what are you going to do, just put this in over the—

Mr. LILJEQVIST.—(Interrupting.) Yes, we saved an exception.

Mr. LYMAN.—Over the rule?

Mr. LILJEQVIST.—Yes, we saved an exception and offer it in evidence under the statute.

Mr. LYMAN.—Well, why do you point out these particular paragraphs?

Mr. LILJEQVIST.—So the court reporter may read them into the record?

Mr. LYMAN.—I don't think they should be in the record without the whole affidavit, without the whole of it is put in.

Mr. LILJEQVIST.—Of course, we are only offering the inconsistent parts.

The COURT.—Let the entire affidavit be made a part of the record.

Mr. LILJEQVIST.—Of course, we are offering that portion in the affidavit as showing the inconsistencies—

The COURT.—(Interrupting.) I think if you offer any of it you ought to offer the whole of it. [1118—559]

Mr. LILJEQVIST.—I don't think we ought to be bound by their statements; we have a right to show admissions against interest.

The COURT.—I don't think it is relevant at all.

Mr. LILJEQVIST.—We offer those parts for the purpose of showing inconsistent admissions

against interest and I don't desire to be bound by self-serving declarations.

The COURT.—All right.

Mr. LYMAN.—The stenographer understands that no part of that affidavit is to be copied into the record,—that the affidavit as a whole is marked for identification.

The COURT.—File the affidavit and refer in the record to the parts that counsel called attention to.

Mr. LILJEQVIST.—That is all.

The affidavit above referred to was that previously marked Defendant's Exhibit "C," and the portions of said affidavit so offered by counsel for the defendant are here identified in this record as Defendant's Exhibit "A–60."

Mr. LILJEQVIST.—Now, we offer in evidence, may it please the Court, as a statement of the interpretation of the Warren Brothers Company of their 1903 patent, this portion of the testimony of the witness George C. Warren in reference to the pavement laid in New Bedford, appearing on page 26 of the certified copy of his testimony given in the District Court of the United States for the Southern District of California, Southern Division, wherein Warren Brothers Company is complainant and C. M. Thompson and others are defendants, namely, quote again: "Now, go ahead and tell us just what you said about that same particular thing—." [1119—560]

Mr. LYMAN.—(Interrupting.) Just one mo-

(Testimony of George C. Warren.)

ment; this is what you asked Mr. Warren about, or is it?

Mr. LILJEQVIST.—Yes, and I didn't get a categorical answer; it touched what I claim the testimony is.

The COURT.—What do you claim for that character of testimony? Now, this is a corporation suing here, and a corporation is not bound by the declarations of its officers.

Mr. LILJEQVIST.—This is a claim by the corporation.

The COURT.—That doesn't make any difference; suppose the officers went out on the streets and admitted that, it couldn't bind the corporation. You can tell Mr. Warren if you want to, but I don't see what this testimony has got to do with this case.

Mr. LILJEQVIST.—I will call Mr. George C. Warren.

Testimony of George C. Warren, for Defendant.

GEORGE C. WARREN was thereupon called as a witness on behalf of the defendant, and having been previously sworn, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

George C. Warren testified that he is not president of Warren Brothers Company; that he is chairman of the executive committee; that he has been president; that he was not president on November 8th, 1921, when he testified in this case re-

(Testimony of George C. Warren.)

ferred to in California but was chairman of the executive committee. Witness was handed a certified copy of his testimony given in the suit in the District Court of the United States for the Southern District of California, Southern Division, wherein Warren Brothers Company was complainant and C. M. Thompson and others were defendants and was asked to state the thickness of the flush [1120—561] coat or superficial layer placed in the New Bedford pavement and testified to in that case as having been laid under patent 727,505, and answered, "I said there that it was about a quarter of an inch, possibly half an inch, I am not certain. That is as near as I could recollect now." It is rather indefinite but as correct as witness can recollect.

Q. Then your interpretation of that patent, or your brother's interpretation of that patent when you first laid it was that you were permitted to lay a flush coat, if you wish to so call it, from a quarter to a half inch over this so-called wearing surface described in the patent?

A. That was not what was called the flush coat, although the patent clearly states, as I recollect, was the first laid.

Q. Over the first flush coat you laid, was over a quarter of an inch to possibly half an inch on the New Bedford pavement laid under patent 727,505?

A. You are referring, of course, to the Bedford?

(Testimony of George C. Warren.)

Q. Yes, sir. A. That was not a flush coat.

Q. It was not a flush coat? A. No, sir.

Q. But you laid that under that patent, did you not, you testified?

A. That was all intended. [1121—562]

Mr. LILJEQVIST.—For the record I desire to offer a portion of the affidavit given by this complainant in the Warren Brothers versus South Park Commissioners, of which I inquired here, but I don't seem to find it in the exhibits, so I offer in evidence that portion of the affidavit filed in the Circuit Court of the United States, Northern District of Illinois, Eastern Division, wherein Warren Brothers Company was complainant, versus South Park Commissioners, the record of which as heretofore filed shows that it involved the identical patent in suit.

Mr. MONTAGUE.—Of whom?

Mr. LILJEQVIST.—George C. Warren. Wherein said president filed an affidavit—

Mr. LYMAN.—(Interrupting.) What is the purpose?

Mr. LILJEQVIST.—Let me finish my offer. —filed an affidavit stating as follows, quote—

Mr. LYMAN.—(Interrupting.) Now, just a moment; why don't you ask Mr. Warren about that in the same way. I don't see why it is not the same situation we have just been over.

Mr. LILJEQVIST.—I asked him about that matter and I think there is a qualified denial, and I assert and I think I have laid the basis properly

for letting this portion of the affidavit in evidence.

Mr. LYMAN.—Put the whole affidavit in evidence, and I have no objection.

Mr. LILJEQVIST.—All I want here is the interpretation of Warren Brothers Company. [1122—563]

Mr. LYMAN.—You are getting things piecemeal, just some of the things; put it in as a whole.

The COURT.—Put the whole affidavit in if you want to. Of course, that is not the way to impeach a witness by an affidavit, to ask him if he made certain statements in a certain affidavit.

Mr. LILJEQVIST.—I submitted the affidavit to him.

The COURT.—All right, then, what is the use of taking up the time of the Court in that manner. You can file it as a part of the record if you want to.

Mr. LILJEQVIST.—All right, I offer in evidence that part of the affidavit, a certified copy of which is filed herewith, beginning with the words, "Affiant further states," on page 3 at the beginning of the first paragraph on said page, and ending with the words, "now owned by complainant" on said page 3, and constituting the last words in the second paragraph on said page, as showing the claim of the Warren Brothers Company as to what was the alleged contribution to the paving art by the patentee under patent 727,505.

(Testimony of R. S. Dulin.)

Mr. LYMAN.—We object to the inclusion of parts of the document without the whole of it.

Mr. LILJEQVIST.—And I save an exception.

Thereupon, the affidavit last above referred to was marked Defendant's Exhibit "A–61." [1123–564]

Testimony of R. S. Dulin, for Defendant.

R. S. DULIN was thereupon called as a witness on behalf of defendants, and being first sworn, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

R. S. Dulin testified he was city chemist and testing engineer in the Public Works Department of the City of Portland; has occupied that position something over twelve years. Asked what his duties with reference to laying pavements in the city of Portland are, Mr. Dulin stated he had tested all the materials that go into the construction of the pavement and the pavement itself, and in addition to that he is superintendent of the Municipal Paving Company, and under that position he lays pavements. He is familiar with the pavements laid in the city of Portland. He is familiar with the pavements laid in the city of Portland purporting to come under patent 727,505. He is familiar with the Columbia River Highway in a general way. Asked if he made any analysis of the samples brought to him by Mr. Hammerly, district attorney of Multnomah County, witness stated he

(Testimony of R. S. Dulin.)

was called to the grand jury-room, and he presumes that Mr. Hammerly was conducting the case at that time, and he presumes that he was the one that turned them over to witness. They were turned over to witness in the grand jury-room; as samples purporting to come from the Columbia River Highway. Witness thinks he made four tests. There were six samples of the Columbia River Highway turned over to witness by the grand jury, and he made analyses of those samples. He has those analyses with him and gives them as follows: [1124—565]

SAMPLE NO. 1.

Asphaltic cement 7.95%
Passing 1½ inch and retained on ½ inch 26.4%
Passing ½ inch and retained on ¼ inch 16.6%
Passing ¼ inch and retained on 10 mesh 15.3%
Passing 10 mesh and retained on 200 mesh 25.9%
Passing the 200 mesh 7.85%

SAMPLE NO. 2.

Asphaltic cement 8.05%
Passing 1½ inch and retained on ½ inch 37.7%
Passing ½ inch and retained on ¼ inch 16.6%
Passing ¼ inch and retained on 10 mesh 12.8%

(Testimony of R. S. Dulin.)

Passing 10 mesh and retained on 200 mesh 22.9%
Passing the 200 mesh 5.95%

No. 3 was left out, and witness' recollection of that is that No. 3 was a sample that had broken down, that is, what he means by broken down, is that it was brought into the grand jury room and warmed up and broke down and fell apart, they couldn't get a cross-section of it for the test that they wanted.

SAMPLE NO. 4.

Asphaltic cement 6.45%
Passing 1½ inch and retained on ½ inch 39.0%
Passing ½ inch and retained on ¼ inch 14.7%
Passing ¼ inch and retained on 10 mesh 12.2%
Passing 10 mesh and retained on 200 mesh 21.4%
Passing the 200 mesh 6.25%

SAMPLE NO. 5.

Asphaltic cement 7.1%
Passing 1½ inch and retained on ½ inch 39.4%
Passing ½ inch and retained on ¼ inch 16.3%
Passing ¼ inch and retained on 10 mesh 6.8%
Passing 10 mesh and retained on 200 mesh 24.5%

(Testimony of R. S. Dulin.)

Passing the 200 mesh 5.9%

[1125—566]

The same thing happened to No. 6 as also to No. 3.

SAMPLE NO. 7.

Asphaltic cement 8.65%
Passing 1½ inch and retained on ½ inch 27.5%
Passing ½ inch and retained on ¼ inch 20.7%
Passing ¼ inch and retained on 10 mesh 11.2%
Passing 10 mesh and retained on 200 mesh 27.5%
Passing the 200 mesh 4.85%

SAMPLE NO. 8.

Asphaltic cement 7.9%
Passing 1½ inch and retained on ½ inch 40.9%
Passing ½ inch and retained on ¼ inch 13.7%
Passing ¼ inch and retained on 10 mesh 10.2%
Passing 10 mesh and retained on 200 mesh 20.9%
Passing the 200 mesh 6.4%

Witness doesn't know who laid that pavement on the Columbia River Highway; in fact he doesn't know just where these samples came from. He believes Mr. Hammersly could give the description nearer than he could. Asked who the contractors

(Testimony of R. S. Dulin.)

were who were laying the Columbia River Highway, he stated there are several companies, he believes the Warren Construction Company and the Pacific Bridge Company and some other company. Witness has examined other streets referred to by Mr. Walter Warren as having been laid under 727,505 in Portland. Asked what the voids were in those different samples of the Columbia River Highway of which he has given the analyses, he stated the total percentage of voids in the mineral aggregate filled with asphaltic cement in sample No. 1 was 18.08 per cent; the total percentage of voids in the mineral aggregate, including the air voids as well as the voids filled with asphaltic cement, was 21.2 per cent. In sample No. 2, 18.2 per cent and 22 per cent. In sample No. 4, 15.2 per cent an 17.7 per cent. In sample No. 5, 16.5 and 17.5. In sample No. 7, 19.3 and 21.8. In sample [1126—567] No. 8, 17.7 and 21.6. The last figure given in each case is the total percentage of voids in the mineral aggregate, including air spaces or voids that are not filled with asphaltic cement. Air spaces are voids in the mineral aggregate. Witness has made analyses of several of the other streets purporting to have been laid under the Warren patent 727,505 in the city of Portland. In making the analysis he took a cross-section of it and photographed it. He has some of the photographs with him. He refers to the photographs he has as follows: This is the contract on East 28th Street, et al., Holgate to Francis Avenue, laid by

(Testimony of R. S. Dulin.)

Oskar Huber. The date of sample was 6/12/16, June 12, 1916. The length in lineal feet was 7,926; the location of sample was 40 feet north of Gladstone on East 29th, 6 feet from east curb line, designated as bitulithic or crushed rock base, that is what the contract was. The analysis is as follows:

Asphaltic cement 8.6%
Passing the 1½ inch and retained on the ½ inch 38.85%
Passing the ½ inch and retained on the ¼ inch 12.75%
Passing the ¼ inch and retained on the 10 mesh 8.05%
Passing the 10 mesh and retained on the 200 mesh 27.7%
Passing the 200 mesh 4.6%

The total per cent of voids in the mineral aggregate was 20.7%.

He has this tabulation on a piece of paper, and has attached to this paper a true photograph of the cross-section.

Thereupon the tabulation with photograph attached was offered and received in evidence and marked Defendant's Exhibit "A–62." [1127—568]

Counsel hands witness another sheet concerning pavement laid on East Seventh Street, Clackamas to Schuyler and witness states that pavement is supposed to be laid under patent 727,505. Attached to that sheet is a correct copy of the cross-section of the pavement. He has placed the percentage on that sheet and the voids are 21.3 per cent. The

(Testimony of R. S. Dulin.)

analyses are shown on these sheets. The columns at the left of these analyses show what passed through a screen of a designated size.

Thereupon the tabulations with photograph attached last above referred to was received in evidence and marked Defendant's Exhibit "A–63."

Counsel hands witness a sheet purporting to be an analysis of East Fifteenth Street, Prescott to Alberta Street, and witness states presumably that was laid under patent 727,505. The analysis on that sheet is correct. The voids are 20.6.

Thereupon the tabulations with photograph attached last above referred to was offered and received in evidence and marked Defendant's Exhibit "A–64."

Witness is handed another sheet purporting to be an analysis of Montgomery Drive, and he stated he believed that was a street laid under patent 727,505. The voids on that street are 22.4 per cent. It has a true picture of the cross-section on it.

Thereupon the tabulations with photograph attached of Montgomery Drive were offered and received in evidence and marked Defendant's Exhibit "A–65." [1128—569]

Counsel hands witness an analysis of a street, of Division Street, East 41st to East 60th, and witness stated he believed that was laid under patent 727,505. The voids in that analysis are 22.3 per cent. A correct picture of the cross-section is attached.

Thereupon the tabulation with photograph at-

(Testimony of R. S. Dulin.)

tached of Division Street was offered and received in evidence and marked Defendant's Exhibit "A–66."

Witness is handed another sheet of the analysis of Sandy Road, East 72d to East 82d Streets, and witness stated he believed that to have been laid under patent 727,505. The voids are 24.8 per cent.

Thereupon the tabulation with photograph attached of Sandy Road was offered and received in evidence and marked Defendant's Exhibit "A–67."

Counsel hands witness another sheet of an analysis of Seventh Street, Burnside to Hoyt, and witness stated he believes that street to have been laid under patent 727,505. The voids are 19.4 per cent.

Thereupon the tabulation with photograph attached of Seventh Street was offered and received in evidence and marked Defendant's Exhibit "A–68."

Counsel hands witness another sheet purporting to be an analysis of Yamhill, Fourth to Sixteenth Street, and witness stated he thinks that was laid under patent 727,505. The voids are 21.1%. That is an analysis of the entire cross-section with the exception of such portions of the pavement sticking out. On the other side witness has made an analysis of both the top and the intermediate course. [1129—570]

Thereupon the tabulation with photograph attached of Yamhill Street, was offered and received in evidence and marked Defendant's Exhibit "A–69."

(Testimony of R. S. Dulin.)

Witness is handed another analysis of Sandy Road from East 72d Street to East 82d Street and witness stated he thinks that pavement was laid under patent 727,505. The voids in that are 23.3 per cent.

Whereupon the tabulation with photograph attached of Sandy Road last referred to was offered and received in evidence and marked Defendant's Exhibit No. "A–70."

Q. I hand you an analysis of a street and ask you if that was laid by any contractor purporting to act under the 1903 patent or otherwise?

A. No, I don't think so.

Q. Who laid that?

A. The county of Clackamas.

Q. Did it abut up against the city of Portland limits?

A. I believe that this sample was taken a short distance from the city limits; the description is given on it here and I don't quite know where the city limits are here.

Q. Does this pavement meet a pavement purporting to have been laid under the 1903 patent?

A. I believe so.

Q. I mean do they butt up against each other?

A. Oh, yes, I presume they do.

Q. Now, have you noticed the wear on these two streets, one having this material shown in this analysis and one having the material analogous to the tests you have shown here purporting to have been laid under the 1903 patent? A. Yes.

(Testimony of R. S. Dulin.)

Q. When was this street laid by Clackamas County, do you know? [1130—571]

A. I think it appears on it.

Mr. MONTAGUE.—What is the purpose of this?

Mr. LILJEQVIST.—We are showing a combination of rock and gravel laid a long time ago that didn't have bitulithic paving at all that stood up and had a stability a great deal better than the bitulithic.

Mr. MONTAGUE.—Well, we object.

The COURT.—I don't see what it has to do with it; I can't conceive what it has to do with this case, any samples laid of a pavement better than the one laid under this patent.

Q. (By Mr. LILJEQVIST.) Is this pavement laid of a combination of crushed—of gravel, sand and asphalt? A. Yes.

Q. Are the analyses shown upon the sheet?

A. Yes.

Q. What are the voids?

Mr. MONTAGUE.—This goes in over the objection and under the rule.

The COURT.—Yes.

A. The voids is 30.1 per cent, in the wearing surface, what I would call the 2 inch wearing surface, and in the base is 23.6 per cent.

Q. (By Mr. LILJEQVIST.) When was that street laid?

A. In September.

Q. What year? A. 1916.

Q. State whether the same kind of traffic goes

(Testimony of R. S. Dulin.)

over this that goes over the adjoining bitulithic so-called? [1131—572]

A. Oh, I should say about the same traffic.

Q. And will you state whether or not—how this street has worn and stood up under traffic?

A. Well, it seems to have stood up fairly well, portions of it at any rate.

Q. (By Mr. LILJEQVIST.) How has it stood up compared with the bitulithic adjoining it?

A. Well, it seems to have stood up fairly well, excepting of course on the edges where the drainage has been.

Mr. LILJEQVIST.—We offer it in evidence and ask it to be marked defendant's exhibit.

The document last above referred to was marked Defendant's Exhibit "A–71."

Mr. MONTAGUE.—This is excluded, your Honor, and marked?

The COURT.—Yes.

Mr. Dulin stated his laboratory has put together materials and made a test of them, an analysis of them, constituting the enlargement of the sheet asphalt mix of sand submitted by Mr. Hall and Mr. Mullen to witness. What counsel has is the analysis of that; that analysis is correct. The voids by cone method, were 16.8 per cent.

Said analysis was offered and received in evidence and marked Defendant's Exhibit "A–72."

He was asked to state from his experience whether materials going through four screen openings, and four only, would give all the finer anal-

(Testimony of R. S. Dulin.)

yses shown in the specifications in the contract in this suit, and he stated that would [1132—573] depend on the product that you got from your crushing plant.

Q. Well, is it possible for four screens to separate material into all these analyses—

A. Oh, no; no.

Q. (Continuing.) —that are attached to the specifications? A. Which specifications?

Q. That are in the specifications in the contract. I will read them to you, if you desire. I will submit them to you for your inspection. (Handing a paper to the witness.)

A. Why, as the gradings were given there, I should say that you could.

Q. What is that?

A. As the gradings are given in here, I should say that you could.

Q. Through four screens?

A. No, I am running it through three.

You cannot scientifically get such and such a per cent running through a two hundred mesh, such and such a per cent running through an eighty, and such and such a per cent running through a sixty, and such and such a per cent running through a forty, and along up the line, by taking it from the crusher and running it through four openings. Asked to state from his experience what gives stability to a pavement made of combination of rock from an inch and a half down to dust, he stated it depends a great deal on the way the aggre-

(Testimony of R. S. Dulin.)

gate is used or what use it is put to, whether it is stable or not. Asked to explain he stated he should say that if it was mixed with a binder it would give that stability, and in certain cases more stability than in others. For example, a mineral aggregate so graded as specified there would have no stability if it was laid on a concrete base, that is, no useful degree of stability, while if it was laid on a dirt grade it probably would give more useful stability, and if used in conjunction with a bituminous binder, it is reasonable to suppose that it would give a more useful degree of stability on a solid base than it would on a yielding. He would not say that the mineral aggregate itself, by itself, would have any degree of stability worth while laid on a concrete base without a binder to hold it together. The dirt foundation would be the one that would give the greatest stability, for the reason that the dirt [1133—574] would come up through and act as a sort of a binder and fill in the interstices more thoroughly. Asked whether a pavement laid with all the gradations given in these specifications attached to the contract in suit, laid on a street, raked and rolled, whether before the asphalt becomes hard whether that material is displaced and will be displaced by traffic going over it, witness stated it is; it is displaced to a degree. The purpose of putting material into four bins is simply entirely due to mechanical difficulty that they have in certain types of paving plants. If you did not separate it into the four bins and recombine it your

(Testimony of R. S. Dulin.)

materials would segregate, and in one batch of a mixture you would get entirely too much coarse material, while in the next batch you would get entirely too much fine material, so that is the reason that they separate them and then recombine them into the proportions that you determine are the proper proportions or in accordance with the specifications. This placing of the materials in the four boxes is the grouping of materials. There is the coarse, intermediate and fine. Coarse is from an inch and a half down to a half inch, and is all put in one bin; then the one-half to one-quarter in a second—that is the intermediate size. Then that passing the ten mesh is the sand portion and put in a third bin. The filler is added from the side. It is not put in the bins, but put directly.

The COURT.—Then when you go to lay a pavement you go and take certain proportions from each bin and remix it at the work?

A. Yes.

The COURT.—So that is not to determine the proportion that is used by the pavement?

A. No, it is simply segregated.

The COURT.—You first use the screen to segregate it?

A. Yes. [1134—575]

Mr. LYMAN.—I didn't get what the witness said as to the third box. You said the first box had material from one and a half to one-half, the second box, intermediate, one-half to one-quarter; the third box, what?

(Testimony of R. S. Dulin.)

A. Well, I got a little mixed up on that, because our method is inch and a half to the half inch, and half inch to eighth, or practically the tenth, and then from that down with the fine material or sand.

The COURT.—That is in the third box?

A. Yes.

Mr. LYMAN.—And your filler in the fourth box?

A. Well, it is on a side, you know. We add that, you know, by bucketfuls, or some other device of measurement. We keep that entirely separate from the others.

Q. (By Mr. LILJEQVIST.) In your plant, then, how many boxes do you have—or how many bins do you have?

A. Why, only three.

Q. And you had the filler from another compartment, as I understand you?

A. Yes, it is entirely separate from the other mineral aggregate.

Q. Well, then, your filler really constitutes a separate bin, doesn't it, for practical purposes?

A. Yes, practically so.

He believes that the last few years the Warren plants have generally four bins. He hasn't examined any of them very closely recently. By filler witness means the dust. Warren plants used to have six bins. Doesn't know whether that is the number any more or not. It is somewhat doubtful whether or not a scientifically mixed grading, using

(Testimony of R. S. Dulin.)

sieves with all the gradations shown in the specifications attached to the contract in suit if put into a mix and mixed into a homogeneous mass and so arranged from a cone test that each succeeding size would fit into preceding size, would give exactly that kind of a mixture after it goes through a machine and is dumped on a street. It would probably come near. Witness doubts somewhat that it is practical to get the exact proportions hand-put into a truncated cone and duplicate that out on the street. Witness would say that the raking has quite a bit to do with the ultimate paving, aside even from the grade, if [1135—576] you want to get the proper grade on the surface. For example, even in the very best regulated plants there sometimes will be accidents happen—a box man will pull too much coarse material and get too much in one batch. When a load is dumped there will be more or less of a segregation there. The city depends very much on their shovelers and rakers to work this around so as to make a uniform pavement. It is not great, but it is noticeable. Counsel refers to some previous reference made to the intersection of Fifth and Morrison Street as having bitulithic surface, and witness states that has been resurfaced by the municipal paving plant. From his memory he would say that was done about October, this last October. The kind of mix was their standard asphaltic concrete No. 1; aggregate passing the one and one-half screen and retained on the one-half screen, 15 to 35 per cent—this is the specifications.

(Testimony of R. S. Dulin.)

Witness makes up that mix. Witness attempts to divide between the fifteen and thirty-five, get between the fifteen and thirty-five, and that is also dependent somewhat on the particular kind of pavement that he is laying. If he is laying a pavement that is two inches thick, he runs more nearly to the 35 per cent than to the 15, but if he is laying a thinner pavement, where it is just a thin surfacing, he holds nearer to a fifteen per cent, and that holds good almost all the way through this specification. Continuing the specifications—passing the one-half and retained on the one-quarter 9 to 15 per cent; passing the one-quarter and retained on the ten, 6 to 12 per cent; [1136—577] and passing the ten and retained on the forty—he has made this simply a division in here, but he doesn't follow it at the plant, because it all goes through the same thing —10 to 15 per cent; passing the forty and retained on the two hundred, 20 to 34. The last two should be combined if you want to meet the exact box weights or bins. Passing the two hundred mesh screen, 4 to 8 per cent. And the asphaltic cement, 7 to 9 per cent. Witness believes he is familiar with the pavements referred to as having been laid in the city of Portland under this patent 727,-505. Asked regarding the kind of a top surfacing there is upon such pavements, he stated that all the streets that he remembers of at the present time that have a heavy traffic have got rather a fine mixture on top, such as he believes the Warren people refer to as seal coat. He can't say that that was put

(Testimony of R. S. Dulin.)

on at the time of the laying of the seal coat, or anything of that sort, but it has accumulated there. The thickness is variable—probably from an eighth of an inch up to about an inch. Asked to compare that surfacing with a sheet asphalt top of an inch upon an asphaltic concrete base, he stated it will protect the large pieces of mineral aggregate seems to give about the same service; a little better if anything. Where this coat is upon these pavements, the mosaic-effect pavement is cushioned by this surface. Any cushion that is put on there protects to a degree, because a load is always deflected depending upon the thickness of the surface that will be on it; the load is spread out, deflected. He would say that cushioning had something to do with the preserving of the life of this mosaic-effect pavement. [1137—578]

Q. From your experience and observation, if there would not be this cushioning coat on the heavy traffic streets, what would happen to this mosaic-effect pavement?

A. Well, I don't know—I really couldn't say just what—just how much; there is no way of measuring it that I know of.

But the situation and the fact is as he has stated it on the heavy traffic streets of Portland. Asked by the Court whether that wearing coat or surface that he speaks of was put on when the street was originally laid, or whether it is the result of traffic over the streets, he stated it is really both, because when the pavement is originally laid there is a flush

(Testimony of R. S. Dulin.)

coat required. This flush coat, he would say, was less than an eighth of an inch thick itself—probably quite a bit less than an eighth, and then there is stone chips or fine material spread immediately on this, and traffic, of course, rolls it into the pavement. The remainder partially comes up through the street by the force of the traffic and partially by the method that they have of maintaining some of those particular type streets. Asked to describe that method, he stated if a pavement appears to be what we call too dry or apparently not enough bitumen in the surface, or a surface has an excess of voids in the surface, it may be flush coated and fine material added to that. It has been done on certain streets here intermittently for several years. There were a number of the streets purported to have been laid under patent 727,505, sanded last Sunday; because the hot weather brings the asphalt to the surface. Usually once a year they take care of that trouble. The first hot spell is when the asphalt comes to the top, and if you take care of that one time it doesn't seem to make [1138—579] much difference how hot it gets the balance of the year, you don't have any difficulty any more. They used to put stone chips in that mixture, but it has been their practice lately to put in concrete sand; it is so much coarser than sheet asphalt sand or sand used in the body of a bituminous pavement. The Warren people used to do that when the streets were under their making; before a certain period of time elapsed. He thinks the Warren people did

(Testimony of R. S. Dulin.)

virtually the same thing as he is doing on behalf of the city. He has never had to do that with sheet asphalt pavement in Portland. He has examined Fifth and Yamhill Streets only in a general way; not made any careful examination of it. He believes the intersection of Fifth and Yamhill Streets was laid under this patent. It has considerable thickness of cushion coat.

Cross-examination.

(By Mr. LYMAN.)

Generally speaking, these accumulations on some of the bitulithic streets on the surface occur in the heavy traffic streets. Fifth Street is the one that comes to his mind, probably the best example of that. And Yamhill Street, he believes from Fifth Street to about Sixth Street. And Taylor Street between Third and Second; and almost the entire contract of the Union Avenue job. He believes that contract extends from Holladay Avenue to Alberta Street. This is just from memory; he is not quite certain of these limits. Williams Avenue. Thinks portions of Grand Avenue; is not quite certain about that; it seems like that Grand Avenue is a Hassam pavement, but he thinks [1139—580] there is some Warrenite. He may have it confused with Union down at that end. He thinks those are the most notorious examples of this building up of accumulations. Couldn't give exact measurements but he knows that in Union Avenue it is pushed down from the center to where it is nearly to the

(Testimony of R. S. Dulin.)

top of the curb. Thinks it originally was put at the center of the street but it gradually seems to work down to the curb. So that he finds it of different thicknesses, depending on where the sample was taken. These accumulations have been built up by the bitumen oozing or coming up from below at the first hot spell and being sanded over to prevent its being slippery, and by occasional reflush coating.

Q. Well, on the great bulk of the bitulithic or Warrenite streets there isn't any such phenomena, is there?

A. Well, of course, I stated only where there was intense traffic.

Q. Yes; I was just getting the scope of your statement. Your statement applies only to cases where there is heavy traffic and it has been necessary to reflush coat it frequently?

A. Yes, that would be correct.

Asked to describe his method of making void tests, he reads his own method of short rule as follows: Multiply the specific gravity of the finished pavement by the percentage of weight of asphaltic cement and divide the product by the specific gravity of the asphaltic cement. Example he has given is 2.37 as the specific gravity of the mineral aggregate, times the volume, divided by the specific gravity of the asphaltic cement, gives the percentage of voids in the mineral aggregate filled with asphaltic cement. This follows from the fact that in a cubic foot of pavement there is a specific gravity

(Testimony of R. S. Dulin.)

of 2.37, of which we have 8.05 per cent of asphaltic cement, we have 62.4—that is 62.4 is the weight of a cubic foot of water—everything is referred back to water to get the gravity—62.4 times 2.37 times .0805 pounds of asphaltic cement. This [1140—581] divided by the 62.4 times the 1.06, the weight of a cubic foot of asphaltic cement, gives the volume per cubic foot occupied by it, and hence the voids are 62.4 times 2.37, the gravity of the mineral aggregate, times .0805, divided by 1.06 times 62.4, equals .179 cubic feet, or, multiplied by 100—or 17.9 per cent of voids. Asked to tell how he would go to work to find out the per cent of voids in the surface specimen of the pavement, he stated he would take any one of these samples and would determine the specific gravity of the sample by weighing it in and out of water—the difference is the way you arrive at the true specific gravity of the sample. Then the sample is warmed up so that it can be well mixed and put in a Rotorex and the bitumen extracted. After the bitumen was extracted that portion that is retained on the ten mesh screen is considered the rock or the heavy portions of the mineral aggregate. That is then calculated to a solid, or multiplying it by the weight of water, 62.4. A cubic foot of water weighs 62.4 pounds. You multiply your weight of mineral aggregate which has got voids in it by your 62.4, and that refers it back to a solid, so you calculate your mineral aggregate as a solid; you set that down by itself there. Then you take your sand and repeat

(Testimony of R. S. Dulin.)

the same thing to determine the gravity of that and calculate that to a solid; and your asphaltic cement the same; you total those, and that gives you the true specific gravity of the sample, provided it is a solid; then you subtract the difference in gravity between what it is as a solid and what it actually is, and that gives you your percentage of voids. That is the method which he followed [1141—582] in arriving at the void results which he stated with reference to these pavements of which he submitted photographs. There was one sample—he doesn't recollect which one—that was a proposed mix that he used the cone test to determine the voids. The reason he used the cone was that was a proposed mix. He wanted to see what it would be with the cone method, is the only reason he knows for it. He would have had to make a sample up and lay it on the street and rolled it if they had done it any other way. In the mineral aggregate alone the cone method is accurate; before the pavement is laid, when he is making up his materials. He doesn't know of anyone else that has used it except the Warren Brothers. There may have been other people used it. Doesn't know if the State Highway Commission used it, in this case; probably they did. The Commissioner of Public Works, who is witness' superior, ordered these photographs made. Asked how he picked out the streets from which to take samples, he stated that on most of those pictures it states that some utility company made the cut in the street, and whenever witness happened

(Testimony of R. S. Dulin.)

along and saw a cut, why, if it was convenient he would pick up a sample and take it to the laboratory. Sometimes the commissioner might do so; other people might do so. He has included there, to the best of his knowledge and belief only samples that he took to the laboratory himself. These are photographs of the actual samples he has had in his laboratory possession for a period of years; they have the negatives in the laboratory. Hasn't the original samples any more. [1142—583] These are not all the photographs of the bitulithic streets that he has; he has a great mass of them. These analyses of the constituents of these pavements shown in the photographs were in his files, made at the time the sample was taken in each case. He made the void tests at the same time that he made the analysis. The void tests are written in pencil on the back of the photographs, and are not included in the face of the photograph. The reason for that was that he had all the data on the photographs and has been on there all the time, and yesterday evening late he discovered that the voids had not actually been calculated, so he asked a gentleman here that was pretty quick with the slide rule to just figure them and put them on there with a pencil. Those voids were just calculated over night for these samples, but the data was there for several years. He didn't completely calculate it himself, but he furnished all the data.

Q. What about this item on the front page—on the page in typewriting on these sheets, "Per cent

(Testimony of R. S. Dulin.)

voids in finished stock"? In each case it gives that, and I notice in the first one here, which happens to be East Seventh Street, Clackamas to Schuyler Streets, "voids in finished stock, 2.8 per cent." What does that mean?

A. Well, that is the voids that wasn't filled with asphaltic cement, that is, the voids in the mineral aggregate, you might call it, contained air, or voids that are not filled with asphaltic cement. [1143—584]

Asked how he would find out what the voids are that are not filled with asphaltic cement, he stated he would calculate it in a very similar manner to the other. A cubic foot of rock of specific gravity of 2.85 would weigh 2.85 times 62.4 pounds—that is, the weight of a cubic foot of water. That would equal 177.84 pounds. A cubic foot of sand, with the specific gravity of 2.67, which it has been previously determined that this sample had. By sand he means everything passing the ten. The gravity of this sand, 2.67, times 62.4—referring back to water again—a cubic foot of it, is 166.61 pounds. The asphaltic cement, figured at a gravity of 1.06 times 62.4 would be 66.14 pounds. Now, 88.07 pounds of rock would, if measured solid, occupy 88.07 divided by 177.84 pounds of rock, equalling .495 cubic feet. Sand, treated in the same way, 47.92 pounds divided by 166.61 would give you .288 cubic feet. Asphaltic cement, 11.09, divided by 66.14, the total mixture in voids—66.14, would give you .179 cubic feet, the total of the three would be

(Testimony of R. S. Dulin.)

.962 cubic feet, but as this actually occupies after final compression one cubic foot, the air space of the voids is one divided by .962 cubic feet, or .038 cubic feet, showing the percentage of voids equal to 3.8 for the finished pavement. It is calculated to a cubic foot; you make your calculation from the data that you have. You refer everything to a cubic foot to begin with, and then refer that to the weight of a cubic foot of water.

Mr. MONTAGUE.—Well, what I am trying to ascertain is, you have no actual physical measurement of the bulk of your sample at any stage of your proceeding? A. No, you don't need it. [1144—585]

Asked how he happened to pick out these particular photographs that he has produced in evidence, he stated there were a great many photographs in the laboratory that he didn't know anything about, what would really be relevant or irrelevant, and witness suggested to Mr. Hall that he might look those over and if there was anything there that he saw that was of any account, they might make a copy of them. Mr. Hall picked out some of them and then witness went over them afterwards, and the ones that he could not connect up and be certain of he laid to one side—what he means whether he brought them to the laboratory or not. A great many people have brought samples in and said they were from somewhere. Witness only had their word for it, and he wouldn't like to introduce anything like that. He has calculated the voids on a

(Testimony of R. S. Dulin.)

great many samples of bitulithic pavement, some of which he hasn't even a photograph of. Surface voids, or voids that he should say have entrained air will usually run about from seven-tenths of a per cent, or one and a half, one and seven-tenths. He has struck some that run as high as three per cent. The voids in the mineral aggregate will run around close to 21 per cent, above and below; slightly above and below; some of them quite a bit below. Regarding the Columbia River Highway samples, he was present only after the samples were in the grand jury room. They asked witness to come down and tell them how long it would take to make the analysis of those samples. The analyses that [1145—586] he made for them are the ones that he has quoted in his evidence—of the six of those samples. Those samples have been destroyed a good many years ago. They are not among those of which he has produced photographs this morning. Doesn't know whether he can positively identify those on the negatives or not. Did have them for a number of years, but he doesn't know what has become of them.

Q. I understood counsel to ask you something in connection with your procedure in the matter of the four boxes, as to whether by using those four boxes—in those four boxes all the separate grades were separated and screened out from each other. You said that they obviously could not be. That is true, isn't it?

A. I meant that fine—

(Testimony of R. S. Dulin.)

Q. (Interrupting.) Your finer segregation?

A. Yes.

The object of his whole procedure in using those three boxes in making the daily tests is to make sure that in his final aggregate he gets a mixture including all these finer grades that would conform to the specifications under which the pavements are being laid. What he actually does is to take the crusher run of his materials and group them in these boxes; in other words, if there is any grading done at all, why, he makes the crusher do the grading. Sets the crusher so as to get the sizes he wants. In making these analyses which are appended to the photographs of bitulithic pavement, and the analyses of those samples that he testified about that were taken from the Columbia River Highway, his percentages are based upon a hundred per cent including the [1146—587] bitumen. So that, if he excluded the bitumen, the other percentages—and based his percentages upon the mineral aggregate alone, the percentages of material will be correspondingly raised. Counsel's understanding of his testimony that his test is not made of the voids in the mineral aggregate taken by itself alone as such, but simply of the voids in the material as it has been laid in the street with the asphalt cement in place, is correct. In making his analyses of the mineral aggregate, he uses the square mesh with four meshes to the inch, to separate the one-quarter inch material from what goes below.

Q. I infer from what you say as to your method

(Testimony of R. S. Dulin.)

of making of void tests that the amount of voids as you find them in the pavement as laid will depend upon the amount of bitumen that is in the pavement?

A. No, not exactly. That will depend somewhat upon the compression that the pavement has received. It might have even more bitumen than will be required to fill the voids, and still the voids might run high.

Q. Yes, but I mean to say, supposing you had to take an extreme case, supposing you used a mineral aggregate—I mean, you used an amount of bitumen equal in volume to the whole volume of your mineral aggregate, then you would naturally have more than a hundred per cent of voids in the mineral aggregate?

A. Well, we would have the mineral aggregate more than filled.

Q. Yes, that is, you would have more than a hundred per cent? A. Yes.

Q. Of voids. That is, in that sense it would depend entirely upon the amount—depend upon the amount of bitumen that you put in the mixture? [1147—588] A. Yes.

If you run a team over the bitulithic mixture before the pavement was rolled and set, it would mark it, and shove, more or less. It would make a slight mark, give a rutting effect to it. It has been done, but is not considered good practice to cart the material right over the mix as it has been laid on the street, before it has been compressed and

(Testimony of R. S. Dulin.)

cooled, where you have to carry it to a point further on. The effect of it is to make a very slight depression in the surface, which is subsequently rolled out by the roller, and then you will have more compression at that point than you would where the cut had been run. The dent depends on how warm the material is. If it is still pretty warm it will make a greater dent in it than when it is comparatively cool.

Q. Now, supposing you were laying a sheet asphalt pavement, in which you were using sand for your mineral in the ordinary way, supposing you attempt to haul a lot of stuff over that material before the binder had been cooled and it had been compressed, what would the effect of that be?

A. Well, the effect would be greater.

Q. It would run a rut right down to the bottom of the mixture, wouldn't it?

A. It possibly would, depending on the load.

Q. So that that is never done with a sheet asphalt mixture?

A. No, I have never seen that done. [1148—589]

Redirect Examination.

(By Mr. LILJEQVIST.)

Mr. Beal, the city engineer of Omaha, brought a sample to witness' laboratory for analysis. Henry Waller, a member of his office force, made that analysis. Witness did not personally make that analysis. Mr. Waller also made an analysis of the Highland Avenue sample.

(Testimony of R. S. Dulin.)

Statement showing the formula by which they make the void test was offered and received in evidence and marked Defendant's Exhibit "A–73."

Witness testified as to the correctness of this sheet in reference to making the voids. The figures that witness gave in response to question from his counsel to figure the mineral aggregate with the bitumen in it in reference to the amount of the voids in the samples, including the voids with the bitumen in such samples. The result which he read into the record for instance on Exhibit "A–62" in which the voids in the mineral aggregate were given at 20.7 which is the correct voidage in the mineral aggregate itself plus the air voids. The air voids are really in the surface, entrained in there. There are two voids for determination to be calculated out; one is the voids that is filled with asphaltic cement, and the other is the voids that are not filled. Now, to illustrate, supposing that the mixture had not been given enough bitumen to have filled the voids entirely, there would have been air voids plus the amount that was filled with bitumen. In the exhibits similar to "A–62," where in typewriting it says, "Per cent of voids in finished top, 2 per cent," that is the voids on the completed pavements itself. The pavement including the [1149—590] bitumen and mineral aggregate and air voids and all, as it is laid on the street. To determine what the voids would be of that mineral aggregate, if the bitumen were dissolved out of it and the mineral

(Testimony of R. S. Dulin.)

aggregate put together, is the percentage given on the back of the exhibits. Asked how much bitumen he could put into such a mixture without having too much, he stated he would have to know the voids before he could answer the question. There is no way that he knows of of exactly calculating just how much asphalt there would be required to fill those voids on exhibit "A–62." Asked how much excess over the bitumen that he has put into this pavement could he put in there before the pavement would be in suitable shape for street paving purposes, he stated this has got eight per cent on this exhibit, and if you have got anything in excess of eight per cent you will have your voids more than filled. It the asphaltic cement is in very great excess it would make the pavement mark up under traffic; if it was considerably under the pavement would deteriorate just in proportion with the percentage that it was short of that asphaltic cement. The asphaltic cement is the real life of the pavement. If the asphaltic cement was damaged in any way and was not of good quality, it would damage the pavement just to that extent that it would not have a good quality of bitumen; it would deteriorate. That would be true also if he used poor mineral aggregate. The pavement depends upon the material that goes in it. Either bad mineral aggregate would affect the pavement or bad cementing material would affect the pavement, even though he had a scientific grading and a low percentage of voids. [1150—591]

(Testimony of R. S. Dulin.)

Witness has seen some sheet asphalt that wore down uniformly until the last eighth of an inch was gone but does not recollect of any other type, that wore down like that.

Q. Well, what I am asking you is, does bitulithic wear out uniformly down to the last thin slice of it, or does it deteriorate in pockets and break up like other pavements and require repairs? What is the fact in your experience in the City of Portland and vicinity?

A. Well, a fairly good sample of that will be on Flanders Street. Flanders Street we have repaired so much, to keep it up, you know, that there isn't any chance for it to wear down in any such manner as that.

Q. Does bitulithic deteriorate in spots and break up and disintegrate like other pavements, or does it not? That is what I am trying to get at.

A. Oh, I don't see that I could see very much difference in any of the bituminous pavements, as far as that is concerned. It depends on the age and general conditions under which they lay, the condition of the soil, of the subsoil and foundation, and so on.

Q. Well, I am asking you to describe what has been the experience in laying pavements under 727,505? What happens to them, if anything?

A. They have all been repaired.

Witness knows the highway down to Linnton. He believes there was a section there that was laid under this patent 727,505. Asked if that

(Testimony of R. S. Dulin.)

was a fair sample of bitulithic pavement, he stated he never made any test of it [1151—592] and he doesn't know any other place that there is exactly the same condition of traffic, but the pavement as originally laid, why, it appeared to witness like the ordinary variety of bitulithic. They have had considerable trouble down there. He never followed the matter up. Doesn't know exactly the cause of the trouble, but they had considerable trouble with that one stretch that Oskar Huber laid there. Witness hands counsel the tests he made of the Beal and other samples.

Testimony of Henry Waller, for Defendant.

HENRY WALLER was thereupon produced as a witness in behalf of the defendant herein, and, having been sworn, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

Henry Waller testified he made the analysis of the sample of Highland Avenue offered in evidence here which was broken off by Mr. Schutte and Mr. Hall and brought up to Mr. Dulin. The analysis of the specimen identified by "Defendant's Exhibit, North Hiland Avenue" and referring to Defendant's Exhibit "A–53" was as follows: bitumen 2.9 per cent; passing inch and a half and held on the half 41.2 per cent; passing the half and held on the quarter 25.8 per cent; passing the quarter and held on the ten 17.7 per cent; passing the ten and held on No. 40, 5.6 per cent; passing No. 40

(Testimony of Henry Waller.)

and held on No. 80, 2.2 per cent; passing No. 80 and held on two hundred 2.7 per cent; passing two hundred 1.9 per cent. [1152—593]

RECAPITULATION.

Passing 1½ inch and retained on ¼ inch 67.0%
Passing ¼ inch and retained on 200 mesh..28.2%
Passing 200 mesh screen 1.9%

Mr. Waller also examined and made an analysis of a sample brought to him by Mr. Beal, City Engineer of Omaha. That was sawed in the city laboratory. This was from the wall in Omaha marked Exhibit "W." The analysis is as follows: asphaltic cement 4.4 per cent; passing inch and a half and held on half inch, 51.1 per cent; passing the half inch and held on the quarter 10.3 per cent; passing the quarter and held on the ten, 4.5 per cent; passing the ten and held on the forty, 9.9 per cent; passing the forty and held on the eighty, 8.9 per cent; passing the eighty and held on the two hundred, 6.1 per cent; passing the two hundred, 4.8 per cent.

RECAPITULATION.

Passing 1½ inch and retained on ¼ inch 61.4%
Passing ¼ inch and retained on 200 mesh ..29.4%
Passing 200 mesh 4.8%

Cross-examination.

(By Mr. LYMAN.)

In making his analysis of this Hiland Avenue sample he did not use the whole sample from top to bottom; he cut out the part which seems to be the base, the bottom layer. There appears to be a

(Testimony of Henry Waller.)

slight division between the top and the base. They cut out the lower part of the sample, using the top layer of about two inches. The bitumen appeared to be coal-tar. He made a void test, but has not the void test with him. It was 22.8 per cent. Witness points out exhibit [1153—594] marked Defendant's Exhibit "W" as that sample from Omaha that he analysed. In making that analysis he used the part below the top. There appears to be a difference between the top and bottom, six or eight inches; cut the top off and used the lower part; cut right down along the line separating the true wearing surface and base, about an inch and a half below the top of the sample. The bitumen in that sample appeared to be asphalt. He made no examination as to the kind of asphalt. He made a void test; hasn't it with him and couldn't give it from memory. Will look at his notes and give it to counsel later.

Redirect Examination.

(By Mr. LILJEQVIST.)

Asked what were the voids in the mineral aggregate on this Omaha sample to which he has just testified he stated he would have that in a minute; he has no note of it here. Counsel hands witness a paper given him by Mr. Dulin in court and witness stated that is the record of what he did. They have calculated the voids entirely on Omaha sample; they ran calculated voids on that entirely; calculated voids, 13 per cent.

(Testimony of Henry Waller.)

Recross-examination.

(By Mr. LYMAN.)

By saying that he calculated the voids in the sample he means he didn't measure the voids in the cone. He just took the specific gravity of the pavement, deducted the asphalt percentage, and calculated the voids and the percentages of the mineral aggregate and their specific gravity. In the other case he used the cone. The case is the regular method. [1154—595]

Counsel for defendant offered in evidence certified copy of the Canadian patent analogous to the American patent 727,505, which was thereupon received in evidence and marked Defendant's Exhibit "A–74."

Mr. LILJEQVIST.—I think Mr. Lyman will stipulate with me for the record, and to avoid taking up the time, that M. M. Hodgman, referred to in the testimony, died in the year 1898.

Mr. LYMAN.—Yes, your Honor, I have no reason to doubt it. It is so stated in the testimony in some of the cases.

Mr. LILJEQVIST.—Counsel referred to the fact that the Supreme Court of the United States did not review the Owosso decision under the certiorari, and for the purpose of showing that that was similar to the usual practice in these cases I ask to offer in evidence a certified copy of the order of the Supreme Court of the United States denying the petition for certiorari in that case, for the record.

Thereupon said certified copy of order of the

(Testimony of Henry Waller.)

Supreme Court was received in evidence and marked Defendant's Exhibit "A–75."

Mr. LILJEQVIST.—Now, may it please the Court, Mr. Van Winkle, the head of the office, has directed us that he thinks it is proper, in the proper performance of our duty to our clients, to ask leave to take the deposition of Clifford Richardson and one Warswick before we close our case, and I have served upon counsel a copy and have filed a motion for that purpose, setting forth in the affidavit the reason for it. [1155—596]

Mr. MONTAGUE.—We object most emphatically.

The COURT.—I suppose the order should not be made, then. That is the same party they applied for once before?

Mr. LYMAN.—That is one of the same parties. The other is a man that is deceased—the other refers to a conversation with Fred J. Warren, deceased, in which he admitted that he had no patent, and I don't think that kind of evidence ought to be introduced in evidence by deposition, anyhow. I think we—

The COURT.—(Interrupting.) Let the motion be filed, but I cannot allow that kind of evidence.

Mr. MONTAGUE.—I might add that we want the record to show that if the matter were to be considered the allegations respecting my agreement with counsel would be pointedly controverted by me.

Testimony of R. S. Dulin, for Defendant (Recalled—Cross-examination).

R. S. DULIN was thereupon recalled to the witness-stand, and testified further as follows:

Cross-examination (Continued).

A. The method here is to take each one of your mineral aggregates, the one above the ten mesh screen and the one below, and calculate them to a solid, as it was done here, you see, and in that way you arrive, you see, at the specified gravity of your mineral aggregate and the voids, then you simply take the specific gravity, which is the one taken here, 2.39, and that is multiplied by the percentage of asphaltic cement. You see the same process right here; right here (indicating)—and this gives you—and then divide it by the specific gravity of the sample, gives you the percentage of voids, which is 19.2 voids, and then there is 1.6 (sic) to be added to that, makes it a slight difference, twenty and one instead of twenty and eight. That is probably a mistake in my figures somewhere. A very slight difference. [1156—597]

Q. (By Mr. LYMAN.) There was a lead pencil note on the back of this sheet showing a—

A. (Interrupting.) No, I think it was here (indicating).

Q. No, it was written on the back of it, "V. M. A.," with some figure.

A. Well, that must be two analyses, then.

(Testimony of R. S. Dulin.)

Q. Well, never mind. This wasn't the one that I handed you. A. Oh.

Q. It was another one that I handed you. I guess I got it mixed up. Well, we have these to look at. I think it would be wasting time for me to inquire further into this matter. That is all, Mr. Dublin.

Mr. LYMAN.—I would like to have this marked for identification, this sheet of figures produced by the witness. Mark it "Dublin's figures."

(The reporter thereupon marked said sheet of paper "Dublin's figures, C. D. R.") [1157—597 (a)]

Counsel for plaintiff read the testimony of LLOYD D. SMOOT, taken on deposition before E. Hilton Jackson, at Washington, D. C., April 28, 1922, as follows:

Deposition of Lloyd D. Smoot, for Plaintiff.

Direct Examination.

(By Mr. LYMAN.)

Lloyd D. Smoot testified he was 43 years of age, occupation general superintendent of Atlantic Bitulithic Company of Richmond, Virginia, residence Washington, D. C. He was at one time connected with the Highway Department of the District of Columbia. He started as a rod man and finished as an assistant engineer; for about the last seven years he was assistant engineer in charge of the resurfacing work. His employment with the department began about 1902 and ended about the middle of 1911.

(Deposition of Lloyd D. Smoot.)

Q. Mr. George W. Beall, witness called for the defendant, has stated that no part of the north side of Pennsylvania Avenue, Washington, D. C., between Twenty-third and Twenty-sixth Streets, has been resurfaced since he first knew the avenue in about 1890, except I believe that he said that a resurfacing of Twenty-sixth Street might have been carried over a short distance on to Pennsylvania Avenue; I refer you to the record constituting Defendant's Exhibit "No. 9," offered in evidence by the defendant in this case, headed "Resurfacing recapitulation of contract No. 1772, Pennsylvania Avenue Northwest, between Washington Circle and Twenty-sixth Street, August 8, 1893." This exhibit includes three sheets of drawings showing Pennsylvania Avenue between Twenty-third Street, or Washington Circle, and Twenty-sixth Street and indicates [1158—598] that 4,411.57 square yards of asphalt surface were placed on this north side of the avenue in 1893 under this contract. Will you please refer to this exhibit and the drawings annexed thereto and tell me whether these indicate that the whole north side of Pennsylvania Avenue between Twenty-third Street, or Washington Circle, and Twenty-sixth Street was included in this resurfacing job.

Mr. BAKER.—The question is objected to on the ground that the record furnished by the exhibit is the best evidence; and no foundation has been laid to show that this witness has any personal knowledge of the resurfacing in question or had any connection with it as a part of his fiscal duty.

(Deposition of Lloyd D. Smoot.)

The WITNESS.—This exhibit shows that the north side of Pennsylvania Avenue, between Washington Circle or Twenty-third Street and to within approximately fifty feet of Twenty-sixth Street was resurfaced in 1893 by H. L. Cranford, contractor. The exhibit shows that the work was completed prior to that date, as the exhibit is marked "final measurement."

Q. What do these plans indicate as to the length of the street between the points where this job began and where it ended?

Mr. BAKER.—The same objection is made to this question.

The WITNESS.—The length of the resurfacing is approximately one thousand and sixty feet; and the width from the car track to the curb approximately thirty-two feet.

Witness is familiar with this class of diagrams and measurements and with the reading of them; he has made numerous ones of exactly the same type while assistant [1159—599] engineer for the district. Asked what the notations on the maps "Station Zero," "Station 1" and so forth indicated he stated the notation "Station Zero" is the approximate point on this street where the resurfacing, or where the curb and the rail were parallel, the same as the other stations up to ten plus seventy-four. The work east of Station Zero is on a curve in the railroad track where more minute measurements were necessary to get an accurate account of the amount of pavement laid. The dis-

(Deposition of Lloyd D. Smoot.)

tance between stations is one hundred feet. The resurfacing work as shown by this exhibit and diagrams was done before witness' connection with the department began, and he has no knowledge about it other than the records of the District of Columbia.

Q. But how about that portion of the street which lies toward Twenty-sixth Street from this station ten plus seventy-four decimal three as indicated on this map?

Mr. BAKER.—The same objection.

Q. Have you any personal knowledge with reference to the question whether that portion of the north side of Pennsylvania Avenue has been resurfaced at any time?

A. I know that it has been resurfaced since that date, since the date of this measurement, but the cause for that small piece between Twenty-sixth Street and station ten plus seventy-four not having been resurfaced at that time is not known to me.

Q. Do you know about how long ago that area between station ten plus seventy-four decimal three and Twenty-sixth Street was resurfaced? [1160—600]

A. I do not.

Q. Can you say whether it was five years ago?

A. I could not.

Q. You know it was a considerable time ago, do you?

A. Well, I can give you an idea but I cannot speak with any authority.

(Deposition of Lloyd D. Smoot.)

Q. Well, let us have your best recollection?

Mr. BAKER.—That is objected to because the witness has said that he has only an idea, but no knowledge.

The WITNESS.—Generally in paving a street, you make the new street conform to the old and with the railroad track being on Twenty-sixth Street—it is my information that Twenty-sixth Street was paved between the time of the original paving of Pennsylvania Avenue and the resurfacing of Pennsylvania Avenue in 1893 and that the paving of Twenty-sixth Street was carried around to and included station ten plus seventy-four on the Pennsylvania Avenue resurfacing.

Mr. BAKER.—I move to strike the answer out as being the opinion of the witness and, therefore, incompetent.

Q. I want to ask you further about how long ago 'you say you know that this portion of the street between station ten plus seventy-four as shown on this map, and Twenty-sixth Street has been resurfaced, within your recollection.

A. The entire pavement at that location has been changed on account of the fact that the railroad track was removed from Twenty-sixth Street and was continued west on Pennsylvania Avenue to M Street. Therefore it was absolutely necessary to pave this section. [1161—601]

Mr. BAKER.—I move to strike the answer out as being argumentative and the expression of an opinion, and not within the witness' knowledge.

(Deposition of Lloyd D. Smoot.)

Q. And can you give us any idea of what work was done? A. I cannot.

Q. Have you personally examined to-day the pavements on Vermont Avenue between H and I Streets; on Massachusetts Avenue between Fifteenth Street and Thomas Circle; and on Pennsylvania Avenue between Twenty-third Street and Twenty-sixth Street.

Mr. BAKER.— Just a moment. The question is objected to on the ground that the information called for would be immaterial and irrelevant to the issues in the case because of the date on which the inspection was made.

The WITNESS.—I have.

Asked in what condition he found Vermont Avenue between H and I Streets, he stated Vermont Avenue as it appears to-day is a conglomerate mess of various classes of pavings and patchings. Starting at the west curb directly in front of the War Risk building for a considerable distance east from the curb and running the whole length of the block there is an entirely new sheet asphalt pavement laid. At various intervals from the east edge of this new paving strip to the east curb of Vermont Avenue there are what is known as plumbers' cuts or cuts for sewers, electric light ducts, water mains, house services, and so forth. These have been repaired from time to time with various classes of asphalt construction. There also exists in this strip of [1162—602] old pavement numerous patches to the worn surface of Vermont Avenue; repairs to

(Deposition of Lloyd D. Smoot.)

these patches have been made with various classes of bituminous materials.

Q. What have you to say as to the condition of Massachusetts Avenue between Fifteenth Street and Thomas Circle?

Mr. BAKER.—The same objection.

The WITNESS.—I will state that the surface of this pavement is in excellent condition with the exception of a few patches and cracks. This pavement, to my certain knowledge, was resurfaced under the direction of J. W. Dare, Assistant Engineer of the District of Columbia, with sheet asphalt pavement, including a binder course to take out depressions in the surface of the old pavement. It is impossible to state anything as to the condition of the old pavement on account of the new asphalt surface.

Q. In your judgment is it reasonable to suppose that a sample taken from these streets or from any of the streets under discussion, at the present time or two years ago would give a fair showing of the construction of the original pavement laid on these streets in the 1870's.

Mr. BAKER.—The question is objected to as being incompetent and immaterial, and calling for the opinion of the witness who has not been qualified as an expert, and who has stated with reference to Massachusetts Avenue that it was impossible, on account of the surface conditions at this time to state what the original paving was and also with reference to Vermont Avenue has said that it has

(Deposition of Lloyd D. Smoot.)

been patched in recent years to such an extent that the same condition obtains there. [1163—603]

The WITNESS.—I would state in connection with Vermont Avenue I will guarantee to go out there this afternoon and I will find sheet asphalt laid on a concrete foundation; I will find a concrete foundation covered with a mixture of sheet asphalt and asphalt binder; and I will guarantee to find portions of the original pavement covered with the resurfacing which was done to the original pavement in about 1879; that a sample, if you happen to strike the original pavement and did not run into concrete or some of these other various forms of construction might lead you to an opinion as to the class of construction, but that you could not definitely state on that particular street until you had examined some more in detail what the class of construction was.

Mr. BAKER.—Defendant moves to strike out the answer as being not responsive, and argumentative, and incompetent.

The condition of Pennsylvania Avenue at the present time is such that either by resurfacing or patching none of the original pavement is at present visible—that pavement which is visible—the present condition of the pavement, though, is bad. Witness mentions Highland Terrace and counsel asks him what he means by that and he stated: Highland Terrace is the roadway adjacent to residences on the north side of Massachusetts Avenue between Thomas Circle and Fifteenth Street; is an elevated

(Deposition of Lloyd D. Smoot.)

road and joins Thomas Circle at the east and Fifteenth Street at the west. That is it runs parallel to the main street but is raised up, he would say, from nothing to fifteen feet at the center of the block. There is very little traffic on the Terrace as compared with the traffic on the main [1164—604] roadway; traffic on the terrace is confined mostly to pleasure vehicles going to and from the residences on this terrace. The main roadway at this point is subjected to quite heavy traffic.

Q. Now, you have spoken of patches at various points; what is the practice as to the making of patches in asphalt pavements in the District of Columbia?

Mr. BAKER.—That is objected to as immaterial.

The WITNESS.—When I was working for the District of Columbia the method of making patches was using identical materials to that with which the pavement was laid; in other words first putting in a binder course after the patch had been cleaned out and then placing a sheet asphalt surface over the top of the binder. In more recent years the practice of the District Highway Department has been to use old material top and binder, removed from streets where resurfacing was necessary, taking this old topping to the district property yard, crushing same with a Noyes crusher, reheating this material in an asphalt plant, adding the amount of bitumen necessary to bring the pavement back to life, then hauling this material out to the street and making the patch with this material. The difference be-

(Deposition of Lloyd D. Smoot.)

tween the first mentioned method of patching and the patching as done now is that the contents of the present patching material includes the stone which made up the binder course of the sheet asphalt pavement.

There are such patches on all three streets that he has been talking about. On Vermont Avenue, they are [1165—605] very numerous; on Pennsylvania Avenue not so numerous as the majority of patches there were evidently done by the sheet asphalt method. On Massachusetts Avenue between Thomas Circle and Fifteenth Street, there are a few patches, one especially large one near Thomas Circle.

Cross-examination.

By Mr. BAKER.—I move to strike out this witness' deposition for the grounds already stated, and conduct the cross-examination without waiving any of the objections to the testimony in chief.

Counsel understands that witness' first employment with the District of Columbia was 1902 when he was rodman; he became Assistant Engineer about 1904 or '05—doesn't know exactly; witness would have to look at the records. He has not personal knowledge of the conditions that existed on Vermont Avenue Northwest from H to I and on Pennsylvania Avenue from Twenty-third to Twenty-sixth Streets and on Massachusetts Avenue from Fourteenth to Fifteenth Streets prior to the time when he became Assistant Engineer of the District of Columbia, nor of the patching of these streets to

(Deposition of Lloyd D. Smoot.)

which he has referred prior to the time he became assistant engineer. The samples referred to as having been taken by Mr. Mullen about two years ago were taken without witness' knowledge. He knows nothing about their being taken at all. Asked if the testimony shows that the sample on Pennsylvania Avenue was taken from the original surface whether he was prepared to say of his own knowledge that that is not true, he stated he knew [1166—606] nothing about the samples. In discussing these plans with reference to the resurfacing of Pennsylvania Avenue, referred to in Exhibit No. 9, his testimony is based on the fact that the District of Columbia has been making similar plans for years and that all plans made for work done on streets are exactly like that plan; and he has made, he supposes, a couple of hundred of them himself based on exactly the same principle. His opinion is expressed entirely from his experience with reference to these plans and by looking at these plans themselves, and his ability to read the plans with which he is familiar. He has a personal knowledge of the territory these plans covered, but he has no knowledge as to whether this contract was carried out specifically or not other than the records show and that the man was paid for the work. It appears on the plans that the man was paid for the work, but witness has no knowledge that he was in fact so. His testimony in this connection is drawn utterly from his experience in connection with such

(Deposition of Donald McNeil.)
plans and from these plans themselves without any personal knowledge. [1167—607]

Counsel for plaintiff at this point read the testimony of DONALD McNEIL, taken on deposition before Clarence A. Williams, at Pittsburg, Pa., May 1, 1922, as follows:

Deposition of Donald McNeil, for Plaintiff.

Direct Examination.

(By Mr. LYMAN.)

Donald McNeil testified his residence was #455 South Atlantic Avenue, Pittsburgh, Pa.; that he is president of the Donald McNeil Company, general contractors, that he is 50 years of age. He was present to-day during the taking of depositions of witnesses Crago, Beck, Johnson, Caskey and Reddy in behalf of defendant. At the time when there was a case pending in the District Court for the Western District of Pennsylvania between Warren Brothers Co., Plaintiff, and County of Allegheny, Booth & Flinn, Ltd., et al., Defendants, witness made certain investigations regarding the old pavements in Pittsburg which have been referred to by witnesses testifying for the defendant to-day. In connection with that case he made certain affidavits which were filed in court in that case. In connection with that investigation he cut samples from the pavements referred to in those affidavits. He looked up the contracts under which the pavements referred to in those affidavits and in the testimony referred to were laid. He found those contracts in

(Deposition of Donald McNeil.)

the old City Hall in the basement, located on Smithfield Street. In reference to the memorandum which Mr. Crago testified from, and which was the subject of some controversy between counsel with the ultimate result that four pages were taken from the memorandum and marked for identification, witness stated Mr. Crago handed the memorandum to Mr. Head in the course of his testimony and before the controversy and Mr. Head handed them to witness; and he had a chance to look it over. Counsel hands witness a document, which [1168—608] witness stated was a document gotten up by him personally. It is a complete history of all the Vulcanite streets laid in the city of Pittsburgh from the first to the last. It also shows the name of the street from where it went to where it ended; the year in which each and every street was built, the firm who built the street, the specifications under which the contract of each street was written. Asked how this latter document compared with the document which Mr. Crago was using in connection with his testimony, and which was handed by him to Mr. Head and from Mr. Head to witness, Mr. McNeil stated he did not have long to compare it but from what he saw of it, it looked like a direct copy of this document prepared by him. Witness prepared this document in 1915 and had about fifteen or twenty copies made of this document. These copies he gave to his friends interested in the streets of Pittsburgh, some went to Boston and some he kept in the city of Pittsburgh. Asked to com-

(Deposition of Donald McNeil.)

pare the four pages marked for identification as a part of Mr. Crago's memorandum with the corresponding four pages of witness' memorandum; he stated the first page appears to be a perfect duplicate, even to the spacing, the manner in which they are arranged and everything else, and even a clerical error which he hasn't had time to investigate. The second sheet, the typing and lining correspond. It seems to be a direct copy with exception of some ditto marks of Booth & Flinn on the side—so is the years; and the third sheet, the streets are in the same order and it appears to be an exact copy all the way through with the same exception, that Booth & Flinn had been dittoed instead of inserted. The [1169—609] last page is practically the same thing. There may be some clerical errors that occur in different copies. There were three or four copies made of the original with carbon copies each time. The document prepared by witness contains in the pages following the four pages which Mr. Crago allowed to be marked for identification, what purports to be copies of the specifications adopted by the city of Pittsburgh governing the construction of Vulcanite streets from the years 1888 to 1898 designated by the numbers 1, 2, 3, 4, 5, 6 and 7, as pertaining to the Vulcanite pavements, and witness stated the copies were made by him personally, from the originals. The number system 1, 2, 3, 4, 5, 6, 7 is his number system and not the number system of the city. Where these four pages refer to specifications as 1, 2, 4, 6, etc., it refers to that para-

(Deposition of Donald McNeil.)

graph in the subsequent part of the memorandum which is headed by that number and which was compiled by witness. These specifications were all practically the same as to foundation, and called for a broken stone foundation covered with an asphalt mixture. The specifications referred to as 2, 4, 5, 6 vary with reference to the other two courses. In some of the specifications they call for 1½ inch binder and 2 inch wearing surface. In others, they call for 2 inch binder course on top of the broken stone and 1½ inch wearing surface. In others, they call for 1½ inch of both binder course and wearing surface. The difference between the specifications being practically the difference in thickness of the binder course and the top course or wearing surface. All the specifications for Vulcanite pavements call for two layers above the foundation. The binder course runs from 1½ inch stone and down. The [1170—610] wearing course must in each and every case pass a screen of ¼ inch mesh. Asked whether he had made a search to find out whether any of the original contracts covering the streets named in the testimony to-day, namely, Bellefield Avenue, Lang Avenue, North Hiland Avenue, and St. Marie St., formerly Bond St., and Elgin Street are in existence or can be found, witness stated he has the original contract of North Hiland Avenue from Bryan north. He also has the original contract for Bond St., now St. Marie St., from Hiland Avenue to Whitman's line. He made on Friday, and must have had at least ten of the city

(Deposition of Donald McNeil.)

employees helping him, a search for the contracts of the other streets. The city has moved into the new building and there was no one he could find that could find any record at the present time of the other contracts. He has the original contract for Dithridge St. from Fifth Avenue to Forbes Street, which is on his list. He got these contracts in the early part of 1915. He doesn't remember the exact date. He compiled them through the Director of Public Work's office, and through the party in charge of the city property at the time and it took him at least three weeks to compile that data. This has been in his possession ever since and was done personally by him. In his affidavit filed in connection with the case of the City of Pittsburg and Booth & Flinn, he took samples from a considerable number of streets including Bellefield Avenue 20 feet north of Forbes St., at the west curb line of Bellefield Avenue, St. Marie St., now, or formerly Bond St., 25 feet east of Hiland Avenue at the north curb line of St. Marie St., Elgin Avenue 21½ feet west of Hiland Avenue at the north curb line of Elgin Avenue; North Hiland Avenue at the west curb line 31 feet north of Elgin Avenue—and [1171—611] Lang Avenue at the east curb line and north of Mead St., and these samples were all in evidence at the trial of Warren Brothers vs. Allegheny County and Booth & Flinn et al. After the trial was over some of them were taken to Boston, some were lost at the court and others went back to witness' office. They laid around the office

(Deposition of Donald McNeil.)

for a long while and some of them disappeared. He has still a sample of St. Marie St., formerly Bond St. The sample was taken by witness personally and marked by him with a seal with a number indicating Number 2. He also has a sample of North Hiland Avenue taken and marked by him as No. 1. The inscription on sample is wrong; it is marked taken by MacDonald. It means Donald McNeil. Witness took these personally himself and this seal was put on with his own fingers.

The sample of Vulcanite pavement from St. Marie Street was taken 25 feet east of Hiland Avenue at the north curb line of St. Marie Street, taken July 21, 1915, at 1:05 P. M. by A. S. Whitehead, Donald McNeil and Harry E. Over. He imagines it was taken very, very close to the point where the sample introduced in evidence by defendant was taken. Witness' sample is typical of the street, showing the original construction of the street at the time. In number 2, the Bond Street specimen, the top course shows a thickness of from 2⅛ inches to 2 inches, with all material passing a ¼ inch screen. The binder course shows material running from 1½ inches down to about ¼ inch. It looks as though the top course and binder course is about four inches. Counsel refers to sample marked No. 1 as taken from North Hiland Avenue, and witness stated this is his sample, and whoever put this label on it put it on wrong. He can identify this sample by his own seal and no one else has the seal of the Donald McNeil Company but him, and this sam-

(Deposition of Donald McNeil.)

ple is Bellefield Avenue sample and not North Hiland Avenue as [1172—612] marked. This sample was taken 20 feet north of Forbes Street at the west curb line of Bellefield Avenue, July 21st, 1915, at 12:05 P. M. by A. S. Whitehead, Donald McNeil and Harry Over. Asked how the point from where he took that sample on Bellefield Avenue is related to the point of Bellefield Avenue where the sample produced by defendant was taken, which the evidence shows was 10 feet from the west curb line, 20 feet north of Forbes Street, he stated it was at the same location on the street, closer to the curb. Asked how he explained the difference in appearance between this sample he took and the sample produced in evidence by defendant marked "Defendant's Exhibit St. Marie Street, A, Crago, May 8, 1922," he stated he would have to explain that by the construction of the Vulcanite pavements. The Vulcanite pavements were constructed with pitch which was very subject to temperature, and the material became soft. At the curb line there was very little traffic, while at the center of the street during extreme hot weather, traffic would tend to push the soft pitch and asphalt combined down into the binder course, more so. In other words, the binder course would come up more to the surface. If you want to get the original of these streets, each and everyone of these streets, the original is at the curb line. His sample shows the street as originally paved and defendant's sample shows the wearing surface worked down into the binder

(Deposition of Donald McNeil.)

course. With the exception of these two samples, he doesn't know where the others are, or where they went to. He examined Bellefield Avenue at the time he took these samples and examined it again Friday morning last. Asked in what portion of the pavement on Bellefield Avenue does the binder course appear up through [1173—613] the wearing surface as indicated by "Defendant's Exhibit Bellefield Avenue, B, Crago, May 8, 1922," he stated that in 1915 he made an estimate and at that time he estimated that there was about 25 square yards of binder course showing, out of the 11,110 yards covered by the contract. From Fifth to Forbes is quite a long block. 11,110 yards. On May 5, 1922, he made an estimate of the amount of binder stone showing through the top course of about 1%, which would be about 110 yards. In each and every sample he took in 1915, from these streets, they all show that the top or wearing surface had been put in according to the specifications which the street called for, of a thickness from 1½ inches to 2 inches, and all the material passing a ¼ inch screen. With the binder course in nearly all larger particles ranging from 1½ inches to ¼ inch. Counsel refers to these samples of pavement marked North Hiland Avenue at Grafton Avenue, 1893, which he has asked to have marked for identification as "Sample of North Hiland Avenue in possession of counsel for defendant, not put in evidence by counsel for defendant," and asked how witness explained the difference in appearance be-

(Deposition of Donald McNeil.)

tween that sample and the sample of Hiland Avenue which he took, witness stated this sample was evidently taken further from the curb line and the top wearing surface has been ironed out into the binder course, and partly over towards the grades, but it shows the construction nevertheless. Instead of being two inches of a top wearing surface, it runs from 7/8 inch to an inch of a fine top wearing surface, all of which looks as though it would pass a 1/4 inch screen. If the label North Hiland Avenue at Grafton Avenue is correct it would be from a spot falling within the part covered by the contract for paving North Hiland Avenue, northwardly, which he produced. Following [1174—614] the collection by him of these samples in 1915, and all information which he collected as to the contracts between Booth & Flinn and the city of Pittsburgh, under which they were laid, and following the hearing on application for preliminary injunction in that case, Booth & Flinn, Ltd. took a license from witness under the Warren patent. Witness has the patent rights for the laying and manufacture of Warrenite in the State of Pennsylvania. He granted a sublicense to Booth & Flinn, Ltd., for the laying of said construction. Booth & Flinn, Ltd., paid him royalties under that license. His agreement with Booth & Flinn, Ltd., was in two ways. Some of the streets they paid a direct royalty, and in other cases they bought the material from witness and he furnished it to them. He can

give the amounts of the royalties paid on some of these roads:

On Thompson Road	$ 1,329.80
Lorries Run and Mt. Nebo Road	1,518.70
Perrysville Road	2,109.80
Troy Hill Road	1,031.70
Freeport Road, #4	1,856.60
Freeport Road #3	829.20
Crab Hollow	720.90
Logans Ferry Road	622.20
Library Road	469.80
Library Extension Road	4,273.60
Total Royalties paid	$16,163.00

On the following roads witness furnished the material which price included his royalty:

Millerstown-Culmerville	$ 25,504.29
Beaver Grade Road	18,417.20
Library Road	7,733.00
Library Road	10,647.12
Coraopolis and Carnot	12,149.66
Steubenville Pike-Enlow Road	19,075.63
Unity & Trestle	10,714.77
Total	$118,106.16

[1175—615]

Counsel hands witness what purports to be copies of two affidavits made by witness in the case of Warren Brothers Co. against County of Allegheny and Booth & Flinn, Ltd., et al., and witness identifies them as being copies of his affidavits. Witness

states the things contained in these affidavits are true.

By Mr. LYMAN.—I now offer in evidence a document identified by you as the statement made up by you showing the history of Vulcanite streets with specifications under which they were laid, etc., as "Plaintiff's Exhibit History of Pittsburgh Vulcanite Streets with Specifications," also three contracts produced by witness McNeal between the city of Pittsburgh and Booth & Flinn, Ltd., respectively, marked "Plaintiff's Exhibit Contract for Paving North Hiland Avenue, Pittsburgh, Pa." "Plaintiff's Exhibit Contract for Paving Bond St., Pittsburgh, Pa." "Plaintiff's Exhibit Contract for Paving Dithridge St., Pittsburgh, Pa."

Also two samples of the pavements produced by witness McNeal and identified by him by the sealing wax upon which is stamped the seal of the Donald McNeil Company, and the Numbers, respectively 1 and 2, the one marked No. 1 being now marked as "Plaintiff's Exhibit Sample of Bellefield Avenue, Pittsburgh, Pa.," and the second one being marked No. 2, now marked as "Plaintiff's Exhibit Sample of St. Marie St., formerly Bond St., Pittsburgh, Pa." The original labels are also allowed to stay on them.

I also offer in evidence the four pages from Mr. Crago's memorandum heretofore marked for identification as "Plaintiff's Exhibit Four Pages of Memorandum Referred to by Witness Crago." [1176—616]

(Deposition of Donald McNeil.)

I also offer in evidence the copies of affidavits of Donald McNeil identified by him as copies of the affidavits filed by him in the case of Warren Brothers Co. vs. Allegheny County, et al., and marked "Plaintiff's Exhibit Affidavits Donald McNeil Identified by Him as Copies of Affidavits Filed in the Case of Warren Brothers Co. vs. Allegheny County, et al."

By Mr. RONEY.—Counsel for the defendant objects to the admission of the "Plaintiff's Exhibit History of Pittsburgh Vulcanite Streets with Specifications" as irrelevant and immaterial, and the "Plaintiff's Exhibit Four Pages of Memorandum Referred to by Witness Crago" is objected to as entirely irrelevant and immaterial, and the "Plaintiff's Exhibit Contract for Paving North Hiland Avenue, Pittsburgh, Pa.," "Plaintiff's Exhibit Contract for Paving Bond St., Pittsburgh, Pa.," "Plaintiff's Exhibit Contract for Paving Dithridge Street, Pittsburgh, Pa.," is objected to as being entirely irrelevant and immaterial; and the "Plaintiff's Exhibit Sample of Bellefield Avenue, Pittsburgh, Pa.," and "Plaintiff's Exhibit Sample of St. Marie St., Formerly Bond St., Pittsburgh, Pa.," are objected to as not sufficiently proven to have been taken from either North Hiland Avenue, Bellefield Avenue or St. Marie St., in the city of Pittsburgh, Pa.

Cross-examination.

(By JOHN H. RONEY, Pittsburgh.)

Witness does not know that the plaintiff com-

(Deposition of Donald McNeil.)

pany paid the costs in the case of Warren Brothers Co. vs. Allegheny [1177—617] County, et al. The two samples he has offered in evidence alleged to be parts of the roadway of Bellefield Avenue and St. Marie St. are very small pieces, comparatively speaking. As much as you would care to carry.

Q. Mr. McNeil, is it a fact that Warren Brothers Co. brought suit against the city of Pittsburgh previous to the suit No. 37 November term, 1915, against Booth & Flinn, Ltd., et al.?

A. Previous to the suit against Booth & Flinn of 1915, I would say not to my knowledge.

Witness is not connected with Warren Brothers Co. in any way. He has a license to lay their material he believes since 1910. In his time, he believes he was familiar with all the suits brought by that company in this district. The Thompson Run Road was put in after the suit of Warren Brothers Co. vs. Booth & Flinn, Ltd. He thinks about 1916.

The road was completed in 1916, and they paid the royalty on the 30th day of December, 1916. That is the first royalty paid by Booth & Flinn, Ltd. Miller's Road was put in in 1916. In those old pavements the asphalt or pitch had a tendency to creep, that was the main drawback.

XQ. 64. That tendency would be more marked nearest to the curb, is that a fact?

A. It would not be so liable to run at the curb because the extra pressure on top of it would not be there but the pressure would be where the heavy traffic is.

(Deposition of Donald McNeil.)

XQ. 65. You misunderstand the question. It is a fact that the pitch or asphalt in the construction of those old roads had a tendency to run from the center of the road to the curb, so that the center of the road would be naturally and unavoidably denuded of the pitch?

A. No. The greater part of that would run down into the binder course. Naturally, when it becomes soft it would go where the open spaces are, and the tendency would be to go close to perpendicular, which would be downward. After that, what didn't go down would go to the side.

It is probable that it would be liquified at the surface or more plastic at the surface than beneath the surface. The pitch would have a tendency to creep toward the curb line, if there was not a certain amount [1178—618] of resistance. He wouldn't say the road was better than originally after a portion of the pitch had been eliminated. Of course, the wearing surface is bound to be better after it worked down into the binder. These various streets he inspected were put down 1891 he thinks to 1897; so that they were in use from approximately 1891 down to 1915, or a period of about 23 years, when he inspected them. Almost every road he went over had been considerably patched, had a number of holes in them and the material was pretty well disintegrated. Some of it was very wrinkled at the curbs. The traffic in the business section of Pittsburgh is heavy; in the residence sections it is not. Bellefield Avenue

(Deposition of Donald McNeil.)

would have very little traffic on it. He has the exclusive right to manufacture or lay Warrenite with the right to lease and allow others to lay Warrenite with the consent of Warren Brothers Company. He was not a party to any of this litigation. Without witness' consent Warren Brothers Co. had no right to license anybody else in this district. They had no right to operate their patent in this district other than with witness' consent. He supposes, according to law, you might term it that he had the granting of this territory. Referring to the alleged sample of the pavement of St. Marie St. witness stated the card that identifies it as a part of the pavement of St. Marie Street has nothing to do with that sample. His mark on that sample is his personal seal put on by himself, and whoever put that card on there he knows nothing about it. The sealing wax does not state that it is a part of St. Marie St. pavement but witness would refer counsel [1179—619] to his sworn statement.

Q. Is it not a fact that the exhibit which is identified by a tag or card on which appears "Complainant's Exhibit Schuttes Sample of Vulcanite Pavement North Hiland Avenue Taken by McDonald" has no identifying marks or other issue to indicate that this is a sample of a part of the pavement of North Hiland Avenue other than the tag which I have referred to?

A. There is nothing on that sample to indicate to any outsider indicating what that sample is. The

(Deposition of Donald McNeil.)

tag is not attached to the sample but tied around the sample and how the tag got there I don't know. The only way to identify the sample is by my sworn statement and my private identification there, which was put on by me with sealing wax and with my own seal and classification.

By Mr. RONEY.—All objected to after the first sentence as not responsive.

Witness does not know what the initials or letters WFH stand for.

Redirect Examination.

(By Mr. LYMAN.)

The numbers 1 and 2 on these two samples produced by witness correspond respectively to the numbers 1 and 2 on the list of samples taken by him, as included in his affidavit in the case of Warren Brothers Co. vs. Allegheny County and City of Pittsburgh, et al. [1180—620]

By Mr. LYMAN.—I withdraw my request that the original of the so-called Flinn receipt of 1891, be marked for identification and transmitted with the other exhibition to the court, its contents having already been read on the record.

Plaintiff offered in evidence four pages referred to by the witness Crago, which was marked Plaintiff's Exhibit 36. As to objections the Court ordered that the record stand as it was made.

Plaintiff offered contracts for paving Bond Street from North Hiland Avenue which were received and marked Plaintiff's Exhibit 33.

Plaintiff offered in evidence The History of Pitts-

(Deposition of Donald McNeil.)

burg Vulcanized Streets with Specifications produced by the witness McNeil and which was marked Plaintiff's Exhibit 34.

Defendant made the same objections to these offers as made by Mr. Roney.

Plaintiff offered in evidence copy of the McNeil previous affidavit which was marked Plaintiff's Exhibit 35.

Defendant made the same objection made by Mr. Roney. The Court ordered them admitted subject to that objection, and held that no new objections could be made nor could additional reasons be assigned for the objections.

To Plaintiff's Exhibit 36 the same objection was made that Mr. Roney made.

Sample produced by witness McNeil marked No. 1 on the sealing wax bearing the impression of the Donald [1181—621] McNeil Company being the sample stated by him to be taken from Bellefield Avenue by Mr. McNeil, was offered and received in evidence and marked Plaintiff's Exhibit 37 subject to the same objections that Mr. Roney made.

Sample produced by witness McNeil bearing figure No. 2 stamped on sealing wax, being the sample stated by him to be taken by him from St. Marie St., formerly Bond Street, was offered and received in evidence and marked Plaintiff's Exhibit 38 subject to the same objection made by Mr. Roney.

Testimony of G. A. Jenkins, for Plaintiff (In Rebuttal).

G. A. JENKINS was thereupon recalled as a witness in rebuttal, and having been previously sworn, testified as follows:

Direct Examination.

(By Mr. LYMAN.)

G. A. Jenkins testified he was the same Mr. Jenkins as previously testified in this case. He heard Mr. Dulin's testimony about analyses of certain samples that were taken from the Columbia River Highway. There were eight samples taken and of those eight there were six, numbers one, two, four, five, seven and eight that were actually analyzed—a part was analyzed by Mr. Dulin's laboratory and part by witness' laboratory—a part of each sample. They split and each took a part and an analysis was made by each on a portion of the same sample and his report bore the same numbers as Mr. Dulin's samples, that is, one, two, four, five, seven and eight, taking the order of the samples. He has all the analysis made by his laboratory and he produces same. There are attached to the two sheets of typewritten matter which he has produced *with* a series of six photographs. Each photograph represents a cross section of the sample in question. Witness did not make [1182—622] these analyses personally. They were made under his supervision in his laboratory. They are part of his regular files.

(Testimony of G. A. Jenkins.)

Said document and photographs were offered and received in evidence and marked Plaintiff's Exhibit No. 40.

Witness read these analyses into the record as follows:

Sample No. 1.

Bitumen	8.0%
Passing 1½ and retained on ¼ inch	53.6%
Passing ¼ " " " 10 mesh	12.7%
Passing 10 mesh " " 200 "	27.1%
Passing 200 "	6.6%
Voids	13.0%

Mr. Jenkins used a standard four mesh screen—not a circular screen—the same as Mr. Dulin used. Mr. Dulin's percentages were based on the total including bitumen, whereas witness' percentages are on the mineral aggregate exclusive of bitumen—that is, the analysis of the mineral aggregate adds to one hundred per cent. The voids in the mineral aggregate of Sample No. 1 were 13.0%. If witness had taken the entire sample at one hundred and applied the same plan that Mr. Dulin did the percentage of the mineral aggregate would be the difference of the bitumen, about 8%; you would have to increase on that first sample with 8 per cent bitumen you would have to take the material retained on the quarter inch as Mr. Dulin has done and divide it by .92 and multiply it by a hundred.

Sample No. 2.

Bitumen	7.7%
Passing 1½ inch and retained on ¼ inch.	53.0%

(Testimony of G. A. Jenkins.)

Passing ¼ " " " " 10 mesh.	14.4%
Passing 10 mesh " " " 200 " .	25.9%
Passing 200 mesh	6.7%
Voids	13.9%

[1183—623]

Witness makes no distinction between air voids and bitumen voids. These are the voids in the mineral aggregate exclusively, as taken by the regular truncated cone method.

Sample No. 4.

Bitumen	7.4%
Passing 1½ and retained on ¼ inch.....	58.7%
Passing ¼ " " " 10 mesh	13.0%
Passing 200 "	6.5%
Passing 200 "	6.5%
Voids	13.8%

Sample No. 5.

Bitumen	7.6%
Passing 1½ and retained on ¼ inch.....	63.2%
Passing ¼ " " " 10 mesh	7.7%
Passing 10 mesh " " 200 "	23.6%
Passing 200 mesh	5.5%
Voids	13.4%

Sample No. 7.

Bitumen	7.9%
Passing 1½ and retained on ¼ inch.....	56.1%
Passing ¼ " " " 10 mesh	10.8%
Passing 10 mesh " " 200 "	28.2%
Passing 200 mesh	4.9%
Voids	14.6%

(Testimony of G. A. Jenkins.)

Sample No. 8.

Bitumen	8.2%
Passing 1½ and retained on ¼ inch	50.1%
Passing ¼ " " " 10 mesh	13.3%
Passing 10 mesh " " 200 "	29.5%
Passing 200 mesh	7.1%
Voids	14.1%

Witness is familiar with the practice of laying bitulithic pavement. Counsel refers to the question asked Mr. Dulin as to whether the mix when laid on the road while the binder was heated would support a team and witness stated the practice has generally been to haul the loads of [1184—624] paving, of hot paving mixture, in over the work that is being laid. That is, they would have to cross the area that had been spread and raked and not rolled. It would make a compression, probably a little more than the roller would make; about a half or three-quarters of an inch. They never follow that practice, to the best of witness' knowledge, with the sheet asphalt mix. The wagons would cut through to the base, and you would tear up the mixture.

Cross-examination.

(By Mr. LILJEQVIST.)

Counsel asks witness if it is not true that the Highway Commission of Oregon has made a rule preventing contractors from hauling materials over their own mixture as they are laying it and witness stated there was a ruling something to that effect but his understanding of it is that it was not a

(Testimony of G. A. Jenkins.)

ruling against hauling the mixture through the hot mixture, but hauling their materials for subsequent work over the pavement that had already been laid. Witness' understanding always was it was to avoid as much of the construction traffic as possible going over the work that had just been completed; the contractor from hauling subsequent materials over the material that had just been laid. In other words, they are asking them not to start the paving in at the plant, for example, and work away from the plant and haul their construction material over the pavement that has been already laid; they ask them to start at the far end and work toward the plant, so as to avoid the construction traffic. They have done that he [1185—625] thinks probably two years, or maybe longer. He supposes in some cases there has been a certain amount of destruction along the edge before the shoulder is put up against the pavement, and they apparently wish to avoid that. The void tests that he has made on the Columbia River Highway samples were made by the cone. There appears to be considerable difference in the results of what the voids are between the cone tests and the method that Mr. Dulin uses. Witness doesn't exactly understand Mr. Dulin's method of figuring, but, as he understands it, Mr. Dulin figures that by calculating from the pavement containing bitumen. Witness has always used the cone method. He doesn't consider the other method as reliable and scientific a method as figuring the voids by putting

(Testimony of G. A. Jenkins.)

them in the cone. Asked if he did not know that it is commonly used by chemists and scientists, he stated he knew that Mr. Dulin uses it; doesn't know who else uses it. These tests that witness has testified to were not made by him. He was connected with the laboratory at the time the tests were made but he didn't actually make the tests. Asked if these are the actual originals of the tests made at that time, without any alteration or change, he stated he can't say from his own knowledge but they are *bona fide* copies of his files that have been in the files since the tests were made in 1916. There is no reason to believe that they are otherwise than what they purport to be. In other words, he simply found them in their laboratory files. Witness didn't see the tests made personally. [1186—626]

Testimony of A. E. Schutte, for Plaintiff (Recalled in Rebuttal).

A. E. SCHUTTE was thereupon recalled as a witness in rebuttal, and, having been previously sworn, testified as follows:

Direct Examination.

(By Mr. LYMAN.)

A. E. Schutte testified he is the same A. E. Schutte that has testified previously in this case. He has heard the testimony of the witnesses for defendant regarding alleged prior uses, particularly regarding alleged prior uses by one F. O. Blake at Denver, with special mention of the alley back of McGov-

(Testimony of A. E. Schutte.)

ern's place. He has made a very thorough investigation of this alleged Blake use at Denver. The matter first came to his attention some time in 1909. Mr. F. O. Blake made an affidavit in one of the cases—he believes it was the Topeka case—citing numerous alleys and several other pieces of work as anticipating the Warren patents, and witness was instructed to go to Denver and investigate the matter there. In that affiadvit Mr. Blake did not make any mention of this so-called McGovern alley. Witness made the investigation at Denver some time before May 29, 1909—May, 1909.

Q. Now, tell us, please, what you did when you went to Denver to investigate?

A. I procured from the city engineering department of the city of Denver the blue-print chart showing all the alleys that had been laid. I have a small copy of the chart here.

Mr. LILJEQVIST.—Now, I object to that as hearsay and no sufficient basis for it laid. [1187—627]

The COURT.—He is just stating what he did now, his own investigation.

A. I had this chart photographed and produce it hereby. It was marked as being made on July 1, 1895. I procured it from Mr. Meryweather, engineer at that time, the same Meryweather who testified in this case.

Mr. LILJEQVIST.—I object as incompetent, irrelevant and immaterial, and no foundation laid, not a certified copy of an official record.

(Testimony of A. E. Schutte.)

The COURT.—He is not introducing it as an official record at all.

Mr. LYMAN.—I am introducing this to explain the story of the witness, to show what he had before him and what he did.

The COURT.—That is all it is for.

A. On this chart procured from the engineering department all the alleys were marked in different colors, and on the edge of it was a description of what the different colors meant, by whom laid, and, furthermore, the names of the contractors laying the alleys and the date of the expiration of the guaranty were marked on this chart. I have this chart here and marked with a red cross every alley that was laid by Mr. Blake which he cited. I examined every single one of these alleys. Some—

Mr. LILJEQVIST.—(Interrupting.) Just a second; I move to strike that answer out as not the best evidence.

The COURT.—He may go ahead.

A. I examined every one of these alleys, some in company with Mr. McGilvery, inspector of asphalts at that time, and chipped a piece out of every alley to see how thick the [1188—628] wearing surface was, and I found that every single one of these alleys had a wearing surface of an inch or inch and a half, in some cases even two inches, of sheet asphalt. That is as far as the alleys are concerned.

Q. (By Mr. LYMAN.) Then what else did you do?

A. I examined—

(Testimony of A. E. Schutte.)

Q. (Interrupting.) Had Blake mentioned—

A. (Interrupting.) Blake mentioned two other streets at the time. One was Waweeta Street—two parts of Waweeta Street. I proceeded to Waweeta Street, and there found a piece of pavement between the car tracks and had a photograph taken, myself standing on the piece of pavement there still in existence.

The COURT.—What street is this on.

A. Waweeta Street. That is the street on the railroad track next to the station that was mentioned all through this. This is another photograph—

Mr. LILJEQVIST.—(Interrupting.) I object as incompetent, irrelevant and immaterial, and for the reason that it bears no evidence showing that this Waweeta Street was in the same condition that this witness saw it, as it was at the time the pavement was originally laid, or any evidence tending to show when it was laid or how the change was made, or when.

The COURT.—Go ahead.

Mr. LYMAN.—You may show his Honor on the map where that is.

A. Here is the Union Station, your Honor. That is this station here. (Indicating.) Here is Waweeta Street, and [1189—629] here is the tracks come right across this street. (Indicating.) There is the Union Station (indicating). I was taken to this spot by Mr. McGilvery, who stated that Mr. Blake had taken some similar samples—

(Testimony of A. E. Schutte.)

Mr. LILJEQVIST.—I object as incompetent, irrelevant and immaterial, and hearsay.

The COURT.—State what you did, what you saw and where you went.

A. I there chopped out a piece of the wearing surface of the pavement, and have it right here with me.

Mr. LILJEQVIST.—For the purpose of saving the record, I move to strike out that answer of the witness in which he stated something about what McGilvery said to him.

The COURT.—Well, your testimony was so uncertain about the location of this alleged anticipating pavement at this place that I don't know but what the Court would be entitled to all there is about it. I couldn't locate it very definitely by your witnesses.

Mr. LILJEQVIST.—I wasn't going to that. I was going to the question of stating what McGilvery said.

Mr. MONTAGUE.—That was excluded, anyway, by the Court.

Mr. LYMAN.—The only thing, if your Honor please, I would like to show by this witness, that he went to that spot because McGilvery—who is now dead, by the way—told him that Blake himself had taken a sample at that spot; that is the reason he went to that spot. I would like to ask to have that appear on the record.

The COURT.—All right. [1190—630]

Q. (By Mr. LYMAN.) Is that the fact?

(Testimony of A. E. Schutte.)

A. That is the fact.

Mr. LILJEQVIST.—Well, I think that is objectionable.

The COURT.—The liberality that has been used in allowing the defense in this case certainly justifies some on the part of the complainant. I think I will let it go in.

Mr. LILJEQVIST.—Save an exception.

A. I there chopped out a piece of the wearing surface and hereby produce it, sealed by myself, having attached thereto an analysis made by myself in 1909.

Mr. MONTAGUE.—Do you want to look at it?

Mr. LILJEQVIST.—Object as incompetent, irrelevant and immaterial and not properly connected as showing the condition at the time it was laid.

Mr. LYMAN.—That is taken at the position or the spot on which you are standing in the photograph?

A. It is.

Q. There seems to be very little of the pavement left there. A. There is very little of it left.

The COURT.—Is that between the tracks?

A. It is across the tracks.

The COURT.—Crossing?

A. Crossing the tracks, under a viaduct just above it. One tower of the viaduct is shown here. I also proceeded, then, to the third spot mentioned, the site of the gas house and the old slate plant, and there secured a typical sample, again with Mr. Mr. McGilvery. I have a piece of that sample

(Testimony of A. E. Schutte.)

with me, sealed by me in the same way as the other. [1191—631]

Mr. MONTAGUE.—Pardon me, are you offering these in evidence now?

Mr. LYMAN.—I think I will now, so as to get them in as we go along.

The COURT.—You say this was taken from the gas plant?

A. The other site mentioned in the—

The COURT.—(Interrupting.) The old gas plant?

A. The old gas plant, yes, sir, where they said they had another of the same pavement.

The COURT.—That is where Mr. Blake testified about?

Mr. LYMAN.—Yes. Now, I will offer in evidence as we go along, first, the chart, the photographic copy of the chart, produced by the witness, as illustrating the witness' testimony.

Mr. LILJEQVIST.—I object as incompetent—

Mr. LYMAN.—(Interrupting.) That may be marked—

Mr. LILJEQVIST.—(Interrupting.) Just a second; object as incompetent, irrelevant and immaterial, and not the best evidence.

The COURT.—Well, I think it is competent to show where he went.

Mr. LYMAN.—To show where he went. That may be marked Plaintiff's Exhibit 41.

Said photographic copy of chart so offered was

(Testimony of A. E. Schutte.)

thereupon received in evidence and marked Plaintiff's Exhibit No. 41. [1192—632]

Mr. LYMAN.—I next offer in evidence the sample produced by the witness as having been taken by him from the intersection of Waweeta and Sixteenth Streets, Denver, and that is marked Plaintiff's Exhibit—

The REPORTER.—42.

Mr. LILJEQVIST.—Objected to as incompetent, irrelevant and immaterial and not properly connected and not purporting to show the condition of the pavement when originally laid, and the witness having no knowledge personally, and all his information based upon hearsay and statements of another.

Said sample so offered was thereupon received in evidence and marked Plaintiff's Exhibit No. 42.

The COURT.—My recollection is indistinct about the defendant's testimony in reference to this particular locality in Denver. Was it to the effect that a part of that pavement that they claim Blake laid is still there in use?

Mr. LYMAN.—No, they said it was all gone, couldn't be found any longer in those places, and there were no samples produced.

I next offer in evidence the photographs produced by the witness showing him at the intersection of Waweeta and Sixteenth Streets, there being three photographs in this group, the third, at the bottom of the group, relating to a matter not yet referred to by the witness.

(Testimony of A. E. Schutte.)

Mr. LILJEQVIST.—What number?

Mr. LYMAN.—That may be marked a plaintiff's exhibit.

Mr. LILJEQVIST.—Same objection.

Said three photographs were thereupon received in evidence and marked Plaintiff's Exhibit No. 43. [1193—633]

The third photograph attached to Exhibit 43 is a portion of the alley between Curtis and Arapahoe streets, Seventeenth and Eighteenth Streets, where witness endeavored to chop out a sample of the Blake Alley to show the typical construction. That is one of those indicated on this map as of Blake construction. Counsel thinks there has been reference to it by the defendant in this case. It is not in front of the Denver Club nor back of McGovern's place. Witness chopped it out of there to get a typical sample of the whole construction, and in chopping through he found the inch and a half wearing surface, it came off readily. Sheet asphalt wearing surface, sand and asphalt mixture—while the lower course was so weak he couldn't get it up at all and he had to leave it there. This photograph shows that place.

Plaintiff offered in evidence sample produced by witness as having been taken by him from a dump at the old gas house site, so called, and it was received and marked Plaintiff's Exhibit No. 44.

Witness found the character of base used in these Blake alleys practically as shown by the contract, which he then carried, a gravel asphalt base,

(Testimony of A. E. Schutte.)

about four inches or thereabouts, then an inch and a half of sand and asphalt, probably. That prevailed through all the alleys that he discovered at that time. He went over every single one of them. The base was a gravel asphalt base. It was simply gravel, more or less loosely held together by asphalt; Cherry Creek gravel. [1194—634] With reference to the alley back of McGovern's place; that is, the alley between Curtis and Arapahoe Streets, between Fourteenth and Fifteenth, witness walked over it but didn't know at the time that it was anything different from the rest of the alley, because he chopped into both ends of the alley, examined the ends of the pavement, and walked over the alley itself, without realizing it was anything different on the McGovern end, and, furthermore, the chart which he had did not show as being anything different in that alley.

He made an investigation as to this particular piece of alley construction back of McGovern's place, he believes the next year, 1910, and again in 1914. Asked how he happened to make that investigation in 1910, he stated it was mentioned in some affidavits before some court at that time, and he was sent down again to see what he could find out. He found the McGovern Alley there showing at some spots coarse aggregate, and he took samples out at that time, which are filed in some case, he don't remember which, but subsequently in 1914 he went there again and secured larger samples and photographs of the alley. He secured a copy of the

(Testimony of A. E. Schutte.)

contract on which that alley back of McGovern's place was laid, and it is in evidence. Witness produces photographs showing two general views of the alley itself. There are two views of the alley, both showing a chalk marked place, the center of the alley and of the McGovern place. That door there (indicating) is McGovern's place. Witness laid it out in the ten sections and had each section photographed, had the camera face right down, and here witness produced the whole photograph of it, that is, the two came together. [1195—635] The dark spot showing on the photograph was the shadows of the telephone post which you can see in the general view. It shows the area surrounded by witness with a red line are sheet asphalt repairs which had been made on the alley by that time, and which is about two-thirds of the alley. This is a photograph of the section 8x25 feet, the property of McGovern, which is supposed to have been laid by a different mixture. The sections which are surrounded by a shaded red line are asphalt repairs. Asked if he knew where the sample was taken from, he said he had it marked on the chart, near the end of the chart, sample taken by A. E. Schutte. Here is the front door and plaintiff's sample was taken right here. (Indicating.) It was taken as a cross section of the alley. The other lines shown in the photograph are the shadows of the telephone poles above the building; they are somewhat distorted because it was some time between the photographs.

The COURT.—Are these repairs?

(Testimony of A. E. Schutte.)

A. Those are repairs.

The COURT.—Now, this is the full width of the alley?

A. The full width and length of the alley.

The COURT.—And that is the McGovern door?

A. The bricks in front of the door.

The COURT.—Then the plaintiff's sample must have been taken over on this side some place. (Indicating.)

A. This side of the repairs. [1196—636]

The Court then asked Mr. Hall, who is in the courtroom, to state just the location of the sample that was taken from McGovern's alley and Mr. Hall stated that: "Measuring from the 14th Street property line of McGovern's, the center of the sample was approximately thirteen and a half feet towards 14th Street. There was some repair in places; Mr. Hall does not remember how close they came to the sample. The outside of the sample was six feet from the door."

Mr. Schutte then resumes his testimony as follows:

The dark lines on the photograph are shadows thrown by overhead telephone poles, they are somewhat distorted because considerable time elapsed between the taking of one picture and the other, while the sun was going down, moving. The traffic conditions on that alley at the time he was there were very light indeed. The photograph shows itself that the buildings or most of them, the livery stable and that sort of thing which requires very little

(Testimony of A. E. Schutte.)

hauling at all. He believes that alley is 50 feet long. It is a very narrow street; he can tell from the chart exactly, they are not very long. These are hundred feet blocks. The alley extends clear up. This is the alley, McGovern's property is here (indicating). There is a livery-stable and second-hand store and that sort of thing. Asked by the Court what is facing on this street (indicating), witness stated just small stores with the exception of this corner here (indicating); that has some magazine supply house, it can be seen from the photograph. While waiting for the [1197—637] photographer he was there one time two hours and he saw two teams go over it, and while he was taking these photographs one expressman was feeding his horse; in fact it seems to be a feeding place for horses in the alley. The only section that seemed to have traffic is the section nearest 15th Street, where there is a magazine supply house. He took a sample at that time, which is marked on his chart and he has it here. He produced the same sample, what was left after making analysis. There are two other samples, this one and this one (indicating).

Plaintiff offers in evidence the photograph of this McGovern alley produced by the witness, which is received in evidence and marked Plaintiff's Exhibit 45.

The sample taken from the alley back of McGovern's by this witness was offered and received in evidence and marked Plaintiff's Exhibit 46.

(Testimony of A. E. Schutte.)

Witness has made analyses of part of that sample. He made four analyses of that sample, of the section which was sawed, of the same sample which he had photographed showing the three pieces of which he has made analysis, and the fourth piece, which is down below, showing the finer mixture. For the analyses he has to refer to an affidavit he made regarding that in the Evans case; it was produced at the time. The analysis of that sample showed as follows: [1198—638]

Bitumen Soluble	6.9		8.1		8.4		10.7
Passing 1¼	4.6)		6.0)		4.4)		0.0)
" 1	12.5)	44.4	7.7)	34.3	6.9)	22.9	0.0)0
" ¾	16.9)		10.9)		5.4)		0.0)
" ½	10.4)		9.7)		6.2)		0.0)
" 4	9.3		11.4		11.6		13.4
" 8	5.1		5.9		6.6		8.2
" 10	12.6		14.6		15.7		21.7
" 20	6.0		8.8		11.5		14.9
" 30	5.6		6.5		8.0		10.1
" 40	4.5		5.4		6.8		9.3
" 50	3.7		4.4		5.9		7.8
" 80	.6		.7		.8		1.2
" 100	2.6		3.3		3.3		3.7
" 200	4.7		4.7		6.9		9.7
Voids in min. agg.....	15.3%		17.4%		18.4%		22%

(Testimony of A. E. Schutte.)

Q. Now, what do those samples or those analyses indicate, as to whether this was a uniform mixture or otherwise?

Mr. LILJEQVIST.—Objected to as incompetent, irrelevant and immaterial, beyond the power of this witness to state, for the reason that the analyses is the best evidence of what it is, the witness not qualified to theorize or speculate in reference to this.

The COURT.—He may be, it is his analysis; I should think he might have some knowledge on the subject after having made the analysis.

A. I have made numerous analyses of it, four of them, produced for this trial and several of it before, and I say that any analysis, no matter what it is, it may be a true analysis of that pavement—

Mr. LILJEQVIST.—(Interrupting.) Now, I object, incompetent, irrelevant and immaterial, not the proper basis.

The COURT.—He said he made several analyses as to whether it is a uniform pavement or not. [1199—639]

A. Examining this specimen which I have produced, it is obvious that if analysis was made of the thicker part to the right of the sawed section; very few stones would be shown. Again, if an analysis were made of the other part more stones would be shown; while if analysis were made of the end it would probably fall between the two, something like that.

The COURT.—What is this part down here (indicating)?

(Testimony of A. E. Schutte.)

A. That is the way it broke off, your Honor, on the pavement.

On the piece of this sample as taken by witness there was some sandy mixture, from which they separated. Something like is shown on his other photograph showing the sample he took the analysis of at the bottom marked with the red line. The four analyses he spoke about were made of samples as indicated on this photograph as now produced—this one from the right side, one from the center and one from the left, and one at the bottom.

The COURT.—What is the length of that, the combined samples?

A. The same as this, your Honor, it is part of the same sample.

The COURT.—You made an analysis of three parts?

A. Three parts, yes, sir, four parts altogether.

The COURT.—I mean three of the wearing surface?

A. Three of what is supposed to be the wearing surface.

Q. (By Mr. LYMAN.) Whatever it is, one of that and one of that. Now, go ahead with your answer as to what these analyses indicated with regard to uniformity or [1200—640] nonuniformity of the mixture used in laying that.

Mr. LILJEQVIST.—Objected to for the same reason.

(Testimony of A. E. Schutte.)

A. The analysis was made of that small section alone, all that small section of about two feet from end to end, showing in one case mineral aggregate coarser than the one-quarter 44 per cent; in another case 34, and the third case 22 per cent, and showing the amount of bitumen being from 6.9 per cent to 8.4 per cent, showing that even in a small sample, the variation is large, and furthermore, an examination of the road showed that any kind of an analysis could be a correct analysis of these samples produced here.

In taking out his first sample in 1909, he attempted to chop off a piece nearer the 15th Street end of the alley, and the material was so friable and breakable that it all fell apart. The four analyses was all sand showing, no coarse material at all in it. The material here, all the material passing a quarter inch screen.

Q. Now, would you expect to find similar results if you looked for and analyzed the samples produced by the defendant in this case at different points?

Mr. LILJEQVIST.—Objected to as incompetent, irrelevant and immaterial, and the witness not qualified to state what the analysis would be if he hadn't made it. [1201—641]

A. An optical observation of the sample, for instance, as marked "B," especially the space that has been faced in with the label, shows it was;

(Testimony of A. E. Schutte.)

anything would be a correct analysis of that alley pavement, depending—

Q. (Interrupting.) Depending on what?

A. Depending entirely where he took the sample. If the sample was taken off the corner, between the label, it would be all fine. If the sample were off the section that faced the door, it would be nothing but fine. Again, if the sample was all taken on top, it would be all coarse, or nearly so.

Plaintiff offers in evidence the small photograph of the specimen taken from the McGovern alley as indicating the section which he used in making the analyses, which is received and marked Plaintiff's Exhibit 47.

Witness worked with Mr. Fred J. Warren in Denver at one time. It was between the years 1896 and '98, he believes, somewhere with the exception of a small time between. Asked if he worked at one time in Mr. F. O. Blake's laboratory as stated in the testimony, he said yes in a sort of laboratory. Mr. Blake had a contract from the City of Denver to lay several streets with an asphalt which he called Grisley, and the city engineer insisted that some chemist should watch while he was producing the material, and witness was sent down there to do so. Witness was loaned to him by Mr. Warren's company. [1202—642] He worked for Mr. Blake in that way during the time that he laid the contract which he had, witness doesn't know, it was two weeks or more,

(Testimony of A. E. Schutte.)

maybe it was a month, he can't exactly tell. Mr. Blake was laying sheet asphalt pavement.

Q. Did you ever hear of his laying—did you ever hear—through him or otherwise while you were in Denver, of this so-called McGovern alley?

Mr. LILJEQVIST.—This is objected to as incompetent, irrelevant and immaterial.

A. I never heard of McGovern's alley until I saw Mr. Blake's affidavit.

Mr. Schutte testified he never heard Mr. Warren speak about Blake's work in any way. Asked if while he was in Denver he heard about or knew about this class of pavement laid in these alleys in which they have this gravel mixture as a base, he stated of course he knew of the alleys in which the gravel concrete was substituted for Portland cement concrete, that is all, the wearing surface being practically the same. It used to be called the alley pavement; sometimes peanut concrete. The wearing surfaces were all sand and asphalt. Asked whether the problems to be solved in the wearing surface of a pavement, to which this patent of Mr. Warren's relates, are different or the same as problems relating to the foundation of a pavement, Mr. Schutte stated the problems are entirely different; the foundation [1203—643] is all there was to support the distributed weight, while the wearing surface has to support the whole weight and the wear besides.

Q. Have you any recollection as to this point, this there seems to be something broken off from

(Testimony of A. E. Schutte.)

the end of the sample, referring to the McGovern alley sample produced by this witness?

A. On numerous places of the alley there seems to be the fine material, as this chart shows; one place in particular I marked referring to this chart.

Mr. MONTAGUE.—Referring to Plaintiff's Exhibit 45.

A. I marked the section fine sand mixture.

The COURT.—You didn't take your samples there, did you?

A. No, I took my samples from this corner, showing both conditions.

The COURT.—I was asking about this (indicating).

A. That seemed to be a fine layer on the pavement.

Q. (By Mr. LYMAN.) That was broken off accidentally in taking the sample?

A. Yes, that corner was broken off as the sample was being removed from the pavement, from the hole.

Counsel gets some of the Pittsburgh samples. Witness has heard the evidence read in this case with regard to some alleged prior uses of the Warren invention in Pittsburgh. He has several times made an investigation of this matter of alleged prior use in Pittsburgh, the last time was in November, 1912. Mr. Blake, in the same affidavit in which he spoke regarding Denver, spoke of Pittsburgh, giving a number of streets, and witness proceeded to Pittsburgh to examine these streets. He can

(Testimony of A. E. Schutte.)

tell what [1204—644] streets he examined; he sent in an affidavit and some photographs. It is all mentioned in the Evans cases. These streets were Homewood Avenue, Lang Avenue, Linden Avenue, Amberson Avenue, Bellefield Avenue, Castleman Avenue and Dithridge Street. Witness made an analysis of Bond Street; he hadn't examined Bond Street at that time. He has a piece of Bellefield Avenue right here, taken November 12, 1912.

Plaintiff offers in evidence the sample taken from Bellefield Avenue by Mr. Schutte, which was received and marked Plaintiff's Exhibit 48.

It is marked right here on the corner November 9, 1912 between Center and Bayard, as the place where he got the sample; about five feet from the curb. The base of this sample is the rough part showing the few large stones of the base, where the smooth part is surfaced. What he has here is the sample of the wearing surface with only one or two stones of the binder.

Q. Now, taking these three samples from Bellefield Avenue which are before the Court—in the first place it appears that the specifications under which these streets were laid called for a foundation of broken stone measuring not more than three inches in any direction nor less than two inches, upon which shall be placed a binder consisting of clean broken Ligonier granite stone not to exceed one and a half inches in diameter well heated through revolving heaters [1205—645] and properly mixed with hot composition through a steam

(Testimony of A. E. Schutte.)

heater which is to be one and a half inches in thickness under the specifications, that coating of fine sand of hydraulic composition being put upon the binder to bring it to perfect grade and smoothness, and that upon this binder surface should be laid the wearing surface or pavement proper, which was to be composed of asphalt cement 14 to 18 parts crushed Ligonier stone 43 to 41 parts, sharp river sand 43 to 41 parts, with sufficient sulphur, lime and cement to harden the asphaltic cement, the whole of this course, of this wearing surface, the material to be screened through a revolving screen with openings of ¼ inch and heated in revolving heaters and properly mixed in a steam heater, to be spread in a layer of one and a half inches in thickness. Now, bearing in mind these specifications, explain if you can the difference between these three samples from Bellefield Avenue.

A. The wearing surface evidently has been thinned by traffic.

Q. In which sample?

A. On this sample marked—

Q. (Interrupting.) The sample produced by defendant marked Defendant's Exhibit "Bellefield Avenue" and bearing the label containing the word "B"?

A. While the other seemed to contain the surface in its natural thickness.

Mr. HEAD.—He says "the other," which is the other?

(Testimony of A. E. Schutte.)

Mr. LYMAN.—Which is the other?

A. While the one marked Plaintiff's Exhibit 37 still has the original wearing surface upon it as near as I can tell. [1206—646]

Q. And how about the sample produced by you?

A. Still has a wearing surface upon it, not quite as thick as Exhibit 37. The pavements evidently have been very soft when they were first laid and it shoved and alligatored very much as shown in my photograph of Homewood Avenue, which shows the alligator appearance, also the job pock marked.

Q. What is this photograph that you are producing? This is a file of photographs attached to your photographic copy of a contract—of the contract for the pavement of Dithridge Street. Please explain to his Honor what those photographs are.

Mr. LILJEQVIST.—Objected to as incompetent, irrelevant and immaterial.

A. These photographs are photographs I have taken of a contract which was lent me by the City Hall of Pittsburgh, Pennslylvania, and the photograph or photographs I took of the different streets while I examined them, one between Homewood Avenue, which shows the alligator condition, and the running of the pavement, as well as the others; the next one is Lang Avenue, which doesn't show as much alligatoring, but shows the marking creeping on the pavement. The next one is Linden Avenue, which shows alligatoring to a very large extent. The third photograph, the next photograph is a general photograph of Castleman Street,

(Testimony of A. E. Schutte.)

showing the patched condition of the street and the impossibility of getting true samples, nearly two-thirds of the street being repaired with some other material. The next photograph is one taken by Castleman Street—also Castleman Street, showing how the mosaic effect is being produced by the wearing surface wearing off gradually and allowing the [1207—647] stone of the binder to come up to the surface.

The COURT.—That is not in evidence involved in this case?

Mr. LYMAN.—No, your Honor, but that is just like this—

Mr. LILJEQVIST.—(Interrupting.) Now, hold on, I object to counsel testifying. It is immaterial and irrelevant.

The WITNESS.—It is typical of the conditions of the street there.

The COURT.—Have you Bellefield Street here?

A. Bellefield, I think I have, yes, I have Bellefield Street showing the stone coming to the top in some places and being smooth in other places, being a condition just before the condition shown in the previous photograph; I have a ten cent piece lying on the pavement to show the size of the stones.

Mr. LYMAN.—These photographs were taken by or for you at the time when you made your investigation in Pittsburgh?

A. Yes, sir, they were taken by me.

Q. To which you have referred?

(Testimony of A. E. Schutte.)

A. To which I have referred.

Alligatoring is a term used for creeping, producing a condition something like an alligator skin. A technical well-understood term. It is due to the softness of the surface. That indicates the presence in the wearing surface of fine material. Counsel refers to Defendant's Exhibit "Analysis of Bellefield Avenue, Specimen B," and asks witness what it includes and Mr. Schutte states it is evidently analysis of the whole pavement, the wearing surface, binder and foundation and all, the way it looks to him. It shows 60 per cent of

—[1208—648]

Q. Yet the specifications under which the pavement was laid provided that the whole wearing surface should pass through a one-quarter inch screen?

The COURT.—Yes, I remember; evidently the contractor didn't follow the specifications.

Witness at some time has made an analysis of the samples of Bellefield Avenue produced here; doesn't know in which case. The Court's understanding is correct in that it is Mr. Schutte's interpretation in explaining these different exhibits like Defendant's Exhibit Bellefield Avenue that the wearing surface had been worn off and squeezed into the lower area. Witness didn't eamine Highland Avenue; he analyzed the sample sent by Mr. McNeill from Pittsburgh.

Mr. LYMAN.—Make a note at this time on the record, please, that counsel in the presence of the

(Testimony of A. E. Schutte.)

Court correct the mistake made in tagging the Bellefield—by the examiner in Pittsburgh in tagging the exhibits of pavement from Bellefield Avenue and Bond Street produced by the witness McNeill. Adjournment.

May 3, 1922.

Testimony of A. E. SCHUTTE resumed.

Counsel refers to defendant's exhibit North Highland Avenue and witness stated he can find the foundation stones on that sample; they are clearly visible by the nature of the stone being attached to the binder course. He refers to the gray stones at the bottom of the sample. The specification provides that upon this foundation shall be laid a binder consisting of clean broken Ligonierd granite stone not to exceed one and a half inches in diameter properly mixed with bitumen, [1209—649] and so on, and to be spread evenly in such quantities as to be one and a half inches in thickness, and witness points out the binder on the sample. The binder is right between part of the large stones extending to a very short distance of the wearing surface of this specimen.

Mr. LYMAN.—Now, the specification calls for the laying on top of this binder course of the wearing surface, or pavement proper, which is to be composed of asphalt and crushed stone and sand, all of which will pass through the quarter inch mesh, a one-quarter inch mesh. Now assuming that this pavement was laid in accordance with that

(Testimony of A. E. Schutte.)

specification, please explain the condition of the sample offered in evidence by the defendant.

Mr. LILJEQVIST.—Objected to as incompetent, irrelevant, and immaterial, the witness not qualified; the sample itself is the best evidence, which objection was overruled by the Court.

A. In facing the sample, the label of the sample, I find that the northern corner—

Q. (By Mr. LYMAN, interrupting.) What do you mean by the northern corner?

A. The northeast corner.

Mr. MONTAGUE.—The upper right-hand corner.

A. In facing the label. That still contains the wearing surface as originally laid, extending into the binder course, while lower down it has been worn even with the binder course, only being about a quarter of an inch or so and from the surface to the superficial stone, it is clearly seen on the corner mentioned.

Q. (By Mr. LYMAN.) You mean by the corner mentioned where the portion of the binder, where a portion of the original binder course is still to be found, where the seal is attached?

A. Where the seal is attached. [1210—650]

Q. Now, is there any other way you can identify these stones immediately below this surface as being binder, a binder course, rather than the wearing surface? A. Yes.

Q. Other than the measurement from the base?

A. Yes, by the porosity of the structure all the

(Testimony of A. E. Schutte.)

way through, other than a short distance of the top, which is typical of binder, being uniform, of uniform sized stones coated with bitumen.

Q. Now, what is your explanation then of the compactness of the surface of this sample, at the immediate surface?

A. It is simply produced, the compactness is produced by traffic and heat, which crowded some of the parts which wore off into the binder and wore it smooth. This thing is visible in smaller degree in some of the other samples which are in, a stage between; for instance, this sample marked—

Q. Defendant's Exhibit "Lang Avenue."

A. (Continuing.) Where some of the binder stones come to the surface and some of the surface is still there alongside of it.

Q. What is your explanation of the absence of the original wearing surface from the most of this sample, Defendant's Exhibit "North Highland Avenue"?

A. Some of it is worn away and some of it is with the binder.

Q. Since last night you have examined again this piece of Bellefield Avenue, Defendant's Exhibit "Bellefield Avenue"? A. Yes, sir.

Q. On which the labels have been pasted over, have you not? A. I have. [1211—651]

Q. What does that show?

A. I there find a typical case of the upper surface squeezing between the binder stones to such a rate that it cracked and opened up the binder course

(Testimony of A. E. Schutte.)

and makes the stones exposed; this was covered up by the label before.

Q. Now, referring to the other sample of Highland Avenue, is there on that sample, namely, the one identified as sample in possession of defendant's counsel not offered in evidence by defendant's counsel, do you find there portions of the wearing surface still in place?

A. Yes, I find parts of the wearing surface still on that, with the binder almost coming to the surface.

Mr. LYMAN.—I believe that has not been offered in evidence and I offer it in evidence as plaintiff's exhibit the next number, the sample heretofore marked as sample of North Highland Avenue in possession of defendant's counsel not offered in evidence by defendant's counsel.

Mr. LILJEQVIST.—Objected to for the reason that the deposition shows that this sample has not been connected up and it wasn't upon that portion of the street to which the witness has testified, another portion of Highland Avenue.

The COURT.—Laid at the same time? Does the evidence show that it was laid at the same time or not?

Mr. LILJEQVIST.—I don't know.

Thereupon the specimen of paving of North Highland Avenue was marked Plaintiff's Exhibit 49."

Mr. LYMAN.—This is the fact that we have, it was simply in the possession of defendant's counsel

(Testimony of A. E. Schutte.)

there and all we know about it is what it says on the tag on it, "North Highland Avenue." Now, so much for North Highland Avenue. Then there is sample produced in evidence by defendant called, Defendant's Exhibit "Lang Avenue, Section L," and another [1212—652] defendant's exhibit called "Defendant's Exhibit Lang Avenue, Section B," both referred to by the witness Crago. Will you look at those samples and say what your explanation is of the condition in which you find them, it being a fact that the evidence shows that this Lang Avenue was laid under a similar specification as this before shown to you.

Mr. LILJEQVIST.—Objected to as an assumption of counsel, not shown by the evidence.

A. I find this specimen marked "Crago, Lang Avenue," the same as the Highland Avenue showing the gray foundation stone, the binder course, and the wearing surface worn down to about half an inch, with some of the stones projecting through the top where the wearing surface wore down. The wearing surface is only about half an inch, it is less in some places, even thinner. The same thing holds good on the third Crago sample, except it doesn't show the large foundation stones, but only the binder stones and the small thin section of the wearing surface, some of the binder stones protruding through the top.

Q. Have you tested the sample that you took from Lang Avenue? A. Yes, I have.

Q. Let us see that, please. The samples from

(Testimony of A. E. Schutte.)

some of the other streets that were mentioned in their notice to us, I thought we had a sample.

A. I thought I had a sample, I put in samples of that street.

Q. Well, you can't find it at the moment?

A. No. [1213—653]

Q. But you will make further search and see if you can find it, will you? A. Yes.

Q. Then we come to St. Marie Street, formerly Bond Street, and here we have two samples, one produced by defendant marked Defendant's Exhibit "St. Marie Street," the other identified by the witness McNeil and marked plaintiff's exhibit, sample of St. Marie Street, formerly Bond Street. Now, explain to his Honor what you find to be the fact as to these two samples.

A. They are constructed the same way as the other vulcanite pavement described, the foundation of larger stones and a binder course. In this case the binder course seems to be thinner and is typical wearing surface, made two inches thick, two inches in some places and an inch and three-quarters in some other places. The other sample seems to be the same structure, except the wearing surface is slightly thick in some places.

Q. Practically the same?

A. Practically the same.

Q. Now I show you an analysis, what purports to be an analysis of one of these specimens produced by the witness Crago by defendant and offered in evidence by defendant marked defendant's exhibit,

(Testimony of A. E. Schutte.)

"Analysis of St. Marie Street," and ask you whether that is a proper analysis of the wearing surface only or whether it includes the whole sample?

A. Judging from the— [1214—654]

Mr. LILJEQVIST.—(Interrupting.) I object for the reason the witness is not qualified to answer that.

Mr. LYMAN.—Now, let us come to the samples from Washington. Take first the DeSale Street. Is that—yes, Defendant's Exhibit "A-20." What have you to say regarding that sample?

A. It is practically the same kind as the other Pittsburgh pavement we have just been examining, and an examination of the record shows it was laid under the same name.

Q. Well, is it vulcanite?

A. Vulcanite pavement. I believe the analysis was made by the defendant; it shows a small percentage of stones larger than a quarter, about .3 per cent I think; the analysis shows a small percentage.

Q. (By Mr. LYMAN.) Well, I don't know what that analysis was? Have you got it?

A. I think so.

Q. Well, a trifling percentage anyway?

A. A very small percentage.

Plaintiff offers in evidence a copy of the Scharf patent No. 111,151 of January 24, 1871, which was received and marked Plaintiff's Exhibit 50.

Q. (By Mr. LYMAN.) You are familiar with

(Testimony of A. E. Schutte.)

this Scharf patent that has just been put in evidence? A. Yes, I think so; yes, I am.

Q. Now, in the first place, let me ask you—the records show that this Vermont Avenue stretch was resurfaced in 1880 or thereabouts with an asphalt surface. What does that mean, an asphalt surface. [1215—655]

A. Meaning sand and sheet asphalt.

Q. Now, referring to these samples, can you point out to his Honor what that resurface with the asphalt surface is?

A. The upper—it is the black upper two inches on the intermediate course.

Q. Now, I understand that the defendant's witnesses analyzed that portion of these samples intermediate between this sheet asphalt surface and the red sandstone base particles, is that it? A. Yes.

Q. The sandstone base foundation stone, such portions of it as they could scrape up. Now, assuming that that patent, that that structure was laid; as the records show it was under the Scharf patent 111,151, what have you to say as to that material in between the asphalt wearing surface and the foundation?

Mr. LILJEQVIST.—Objected to as the witness not qualified to. He is testifying as an expert now, which objection was overruled by the Court.

A. My opinion is that it is the binder course and part of the surface. The pavements in those days were very soft in the summer and very hard in winter and ground up into a black powder

(Testimony of A. E. Schutte.)

as shown by numerous books, and if the surface wears off it leaves the binder course filled with whatever is left of it.

Q. That is your explanation of that appearance there, the same as the explanation of what happened in these Pittsburgh samples? [1216—656]

A. Yes, any soft pavement or any pavement of soft compound is the same as the Pittsburgh work with alligatoring on top. They are soft in summer and hard in winter; they are affected both ways.

Q. I will ask you in passing whether you think there is enough of that material left there so anybody could be able to get an adequate—make an adequate analysis of it.

A. There wouldn't be for me; I wouldn't make analysis of material I could scrape up there, for it is impossible to tell which is the foundation stone and which is the other course, for they all look alike from the outside; in order to tell you would have to break the stone; the sawed section of course showed it, without breaking the stone, you can't tell where it belongs. For instance, this stone you can tell where it belongs or any of these others, whether it is sandstone or gravel.

Counsel stated it appears from the Washington records that the north side of Pennsylvania Avenue, Washington, between 23d and 26th Streets, from which defendant's sample, Exhibit "A–19," purports to have been taken, was originally laid with coal-tar pavement under the Scharf patent No.

(Testimony of A. E. Schutte.)

111,151 on or about 1877, and that it was resurfaced with an asphalt surfacing about 1892 and witness on being asked to explain in the light of these facts what this sample, Exhibit "A–19," shows, stated he can't explain because he can't find the asphalt resurfacing. The top inch and a half, which is the part analyzed by defendant's witness, in Mr. Schutte's opinion is a patch of very recent origin, because the flush coat is still on the top, which in Washington wears off very quickly. He has seen hundreds of patches of similar top with the mosaic [1217—657] effect of the patch on the surface. It is a habit in Washington now to patch with that sort of a mixture. Counsel refers to Defendant's Exhibit "A–35," particularly page 12, being photographs of samples taken from practically the same location in Pennsylvania Avenue from which defendant's samples in evidence were taken, and witness stated these photographs show three different sections put on top of the sample. Each one of these sections showing fine surface of more or less thickness over the binder course, and none of them have the upper inch and a half as is found on sample marked Exhibit "A–19," and Mr. Mullen said he discarded that upper surface as not being part of the pavement when he took his samples and photographs. Witness agrees with Mr. Mullen that the upper inch and a half is not part of the original pavement. The original pavement showing the typical structure of large stones in the bottom, a binder course and still a small sec-

(Testimony of A. E. Schutte.)

tion of the upper wearing surface. Practically worn off the binder. A patch may go to the foundation; a patch may be just put on to raise a depression. This kind of a patch would raise a depression where it was worn out. It might extend for considerable area or it may extend for only a very short distance. Witness made an investigation of 24th Street in South Omaha. It was also mentioned in one of the affidavits and he went to South Omaha. He couldn't find the pavement but he found the records under which it was laid—he took a typewritten certified copy of that. The only thing he could [1218—658] find about the pavement was a dump some distance away from the street, where he saw numerous pieces, a great many hundred, of the pavement; all of them so far as he could tell had a wearing surface of sand and fine gravel. In general he doesn't think they were as good as the samples produced here. By "as good" he means as firm. For instance, this sample here was containing as much gravel as the other sample. The samples he saw at the dump were all the gravel mixture. Witness was asked to explain the difference between a three mesh screen and a four mesh screen and which is the more correct method of determining material which is greater than one-quarter inch and he stated he thought the three mesh screen is incorrect, because stones of that size are usually of a more or less slabby nature, break in slabbing pieces, which will go to the diagonal of the mesh and the three mesh screen will allow

(Testimony of A. E. Schutte.)

pieces as large as one-third of an inch to go through while the four mesh screen as used by most people in determining the quarter inch stone is slightly smaller than a quarter inch, but slightly larger in diameter. He means the diagonal of the mesh. The way these screens were adopted was this: when we commenced to work with mineral aggregate in 1900 or thereabouts, there were no standard screens except for testing sand ranging from 10-mesh down, so witness had to adopt some way for getting different relations and he adopted what he thinks is the most uniform thing, which was a round hole, and the patentee speaks of material one-quarter inch in diameter, and that screen brought material through a hole one-quarter of an inch in [1219—659] diameter. But the laboratory tests, a quarter-inch round punched hole is rather difficult to screen through, and he subsequently adopted a four-mesh, which is four meshes to the inch, which gives exactly the same result, or within a very, very small percentage of the same, as the quarter-inch punched hole. Witness adopted these screens twenty years ago, or twenty-two years ago and they have been in use ever since by everybody who uses aggregate, four-mesh, quarter inch round hole.

Witness thinks Mr. Dulin's test for voids is very misleading. In the first place, the patentee speaks of the voids in the aggregate *per se* without the bitumen. Mr. Dulin determines the amount, as nearly as witness can tell from his description, of the voids in the pavement itself, including the

(Testimony of A. E. Schutte.)

bitumen, which is not a correct way, for if we should take an aggregate containing a large amount of bitumen, the stone particles will be so far spread apart that it would not represent at all the void tests or the amount of voids in the aggregate by itself. For instance, assuming 50 per cent of mineral aggregate, and 50 per cent of bitumen, which is of course too much, too big a percentage, then a void test according to Mr. Dulin will show about 125 per cent of voids in the aggregate, which is absurd. It simply means that the aggregate has floated in the bitumen. The patentee himself made all these void tests and described the void tests made on the aggregate itself, which afterwards when combined with the bitumen produced the pavement. Witness has examined the sample of pavement produced by Mr. Hall as representing his idea of what was covered by the so-called 1901 patent. He hasn't made any analysis of this sample and he don't know anything about whether the mineral aggregate in the wearing surface there comes within the [1220—660] specific limits of the claims of that patent. Asked how the foundation on which Mr. Hall's sample was laid corresponded with the 1901 patent, witness stated it doesn't correspond at all. The patentee describes a special prepared foundation, being composed of stone from (he refers to the patent) two to six inches in diameter, upon which then is laid the pavement of specially prepared ingredients, which have reference to their packing and binding character with regard to each

(Testimony of A. E. Schutte.)

other and also with respect to the character of the surface which is to receive it, and of the voids and spaces in it. Now, there is the wells, voids and spaces in which the patentee meant for the body to go into the foundation and be keyed into the foundation, into the spaces, anywhere from two to four inches in the stone and forming with this special foundation layer the structure itself. The foundation that Mr. Hall's sample shows is an ordinary smooth foundation. So that it is impossible to use stones as large as three inches in diameter. And the patent further says: "This layer is a binding or surfacing layer, and it is constituted to unite with the rough surface of the supporting layer by entering the spaces, channels and voids between the stones thereof to a very considerable extent, and also to fill them. It is further constituted to make a continuous homogeneous solid layer of its own composition above the line of union with the layer below, and provides a hard and firm, solid, waterproof, tenacious surface." So that the two have to be considered together. The wearing surface exercises functioning conjunction with the especially prepared foundation. [1221—661] below.

Mr. Schutte was in Denver from 1896 to 1899. In the fall of '99 he came with Mr. Warren to Boston—with Mr. Fred J. Warren, the patentee. In Denver he analyzed pavements, the usual analyses made on pavements, sheet asphalt pavements; extracted bitumen, made a screen test of sands, and checked up the penetration of the asphalt as it was

(Testimony of A. E. Schutte.)

being prepared; the usual thing done in a laboratory for a paving plant. His work was exclusively with sheet asphalt pavement. He went to Boston with Mr. Warren in 1899. The first work in Boston—until about Christmas of that year—he examined California asphalt and asphaltic oils, and immediately after he examined coal tars and its products, various coal tar plants around in New England. Asked what Mr. Warren's business was at that time he stated they were just getting ready to make tar papers and pitches, paving compounds of various kinds. They distilled coal tars, principally, with coal tar distilleries. That work lasted for probably ten years or so. He continued to make the tests of asphalt and coal tar until Mr. Warren bought the output of the Cambridge gas plant and they built their factory and laboratory in Cambridge. That was about six or eight months after, he thinks. Next they made coal-tar compounds for paving, sidewalks, roofs, and all that sort of things, and made disinfectants out of coal-tar products. That work went on intermittently for a long time. It was part of the laboratory work for a number of years; ten years, perhaps. Mr. Warren set witness to work making tests of mineral aggregate. It was some time in 1900, he thinks [1222—662] during the winter, as near as he can recollect just now. It was through the winter of 1900 and 1901. He can't place the date with any accuracy. Mr. Warren told witness to take stones and fill in the voids in the bigger stones

(Testimony of A. E. Schutte.)

with smaller, and so on, and make the densest mixture he could get and report the void tests to him daily, and witness reported to him daily the void tests and the screen tests of the combinations he made. He continued that work for Mr. Warren for nearly a month, he thinks, if not longer. In fact, it continued on for years afterwards, but the preliminary work was a month or so. His first results were very inaccurate, because he tried to use the old ways of cylinders and boxes for making void tests, until for his own convenience he made this contrivance called a truncated cone. He made that at the same time in connection with the tests that he was making under Mr. Warren's directions. He does not mean that the truncated cone is the only correct method of making void tests; it is the only quick method—it is the only method by which one unskilled can make a quick test. You can make a test in various kind of things. For instance, you can take a box made of either sheet iron or of oak, having a space of two or three inches, and carefully fill the spaces in that and shake it down, but in all of these vessels of various kinds, of straight sides, a great deal of skill has to be used in order not to have the segregation of the coarse particles to the bottom and fine to the top, which the cone prevents; and furthermore the cone is very convenient to jar the materials down in. You can take hold of it and jar it, pound it right down very quickly and [1223—663] conveniently. Asked the origin of that phrase "inherent stability" as it

(Testimony of A. E. Schutte.)

appears in this patent, witness stated he thought it originated with Mr. Raymond; Mr. Raymond was Mr. Fred Warren's attorney. Witness doesn't know whether it originated with Mr. Raymond or not but the first time witness ever heard it was from the lips of Mr. Raymond. Mr. Warren was in the laboratory with Mr. Raymond, showing him sand and the aggregate we were making, and witness remembers him distinctly putting the pencil into the sand and working it up and down and saying, "Now you see this is all loose," and putting the pencil in the other box which contained the aggregate, "And this is solid; see how solid this is," and Mr. Raymond said, "This is what might be called 'inherent stability;'" and that is the first time witness heard the word mentioned. The reason he recollects it is because he spoke very little English in those days, and the word "inherent" was new to him and he looked it up. The first time witness heard of Hodgman was in Mr. Blake's affidavit of 1909. Witness never heard of Mr. McGovern's alley pavement until he saw Mr. Blake's affidavit and proceeded down there to find it, because he was sure that no such thing ever existed.

Q. Did Mr. Warren ever mention Blake to you in any way after you left Denver?

A. Not that I know of.

Q. And in Denver did he ever discuss with you Mr. Blake's work in any way?

A. No, not that I know of. [1224—664]

Prior to this work witness did in Boston in 1900

(Testimony of A. E. Schutte.)

at Mr. Warren's direction he never made any effort to combine coarse material for any purpose. The first work he did was at Mr. Warren's instruction. Mr. Warren never suggested such a thing to witness until 1900 in Boston; witness didn't even know what Mr. Warren wanted it for then; he just told him to make these tests. Making screen tests of the sand for sheet asphalt, which witness spoke of doing in Denver. It was a regular routine work, to test the sand for the pavement by passing it through the screens from ten to a hundred, and later on to two hundred. As far as witness knows, there were no larger testing screens than that. He had to make his own when he started to work by punching holes in a piece of tin. In fact, now, even now, round holes are being used for larger aggregate, by everybody.

Q. Now, I would like to direct your attention to some of the prior art literature that has been introduced by defendant. I hand you the quotation from Dobson on "Foundations and Concrete Works" which was there read into the record by the Attorney General, and see what you have to say as to that? A. I have read it before.

Mr. LILJEQVIST.—Object for the reason that the article is in plain and concise English, clear and not ambiguous. Its interpretation is for the Court, and it is not the subject of expert testimony, nor can expert testimony alter the plain language of such a written instrument.

A. This article refers to Portland cement con-

(Testimony of A. E. Schutte.)

crete for foundation and concrete works, and describes a method of proportioning suitable concretes, Portland cement concretes. [1225—665]

Mr. LYMAN.—I hand you a copy of an extract from the work of Thomas Potter, published 1891, which has been read into the record by counsel for the defendant, and will ask you to read that over and state whether or not it has in your opinion any pertinence with reference to Mr. Warren's invention?

Mr. LILJEQVIST.—Same objection.

A. I have read this article a number of times before, and I know the Potter article describing how concrete should be—Portland cement concrete should be made up by filling the spaces with a mortar. It is not at all practicable to use this method in the paving industry; and, furthermore, Potter himself states that while this is good for foundations and other work, for paving purposes it is not suitable. In his second volume, on page—

Mr. LILJEQVIST.—(Interrupting.) Object as immaterial, for the same reason that it is universal experience, pretty near judicial knowledge, that concrete pavement laid on a combination of graded rock and cement is suitable for pavement, whether Potter said he thought so or not—it is simply a question of reference—the description covers—

The COURT.—(Interrupting.) Speaking of reference, now, this has reference to the effect of Potter's work as an anticipation.

A. On pages 124 and 125 of the same work, sec-

(Testimony of A. E. Schutte.)

ond volume by Potter on "Concrete in its Use and Building," Potter says [1226—666] "It was at one time usual to employ an aggregate of various sizes, with a view to the smaller portions filling up the vacancies between the large, but as the paving wore under traffic it was found that perfect homogeneity had not been secured, and the appearance of the paving slabs was not the best. Now the aggregate is almost uniform in size, in general not larger than a pea. The cavities between the fragments being filled with the cement in mixing, and though the absence of sand would tend to weaken the mix, it may be said that the pavement is practically composed of granite and not cement.

Mr. LILJEQVIST.—What year was that published in, the second edition?

A. It doesn't seem to give the date. It is the same edition that you referred to, because we have that in the Owosso case, and the same volume was used there.

Mr. LYMAN.—If you haven't seen it—

Mr. LILJEQVIST.—(Interrupting.) Well, read into the record what edition you are reading from, that's all.

Mr. LYMAN.—It says—

Mr. LILJEQVIST.—(Interrupting.) Published in what year?

Mr. LYMAN.—Well, it doesn't give the date of publication. It simply says, "Volume 2, London, B. T. Batsford, No. 4 High, Holgate."

With reference to the practice referred to in this

(Testimony of A. E. Schutte.)

Potter extract, witness stated in the Portland cement concrete, the stone structure used was as a dilutent, to dilute the mixture, to make it cheaper. The whole function of the stone was to cheapen the structure and use less Portland cement, for the best and strongest structure could be gotten by the biggest amount of Portland cement used. [1227—667] Portland cement makes a rigid, hard structure. And no stability of the aggregate is depended on at all, for even to-day the Portland cement is mixed so soft that when laid in structures it is poured, or, when laid on the street, before the Portland cement sets you couldn't walk over it without going into it up to your ankles on a six-inch concrete base. All the stones and sand are practically floated in Portland cement and water, while in the bituminous structure the cementing material itself could not be used by itself, and there the structure, the mineral structure, forms a wear-resisting ingredient which is only surrounded by the bituminous cement. If too much bituminous cement is used in that case it destroys the very function for which the aggregate was put in. Counsel refers witness to an extract from Sutcliffe, on "Concrete, Its Nature and Uses," introduced in evidence by the defendant, and witness stated that also is for the Portland cement structure. It doesn't teach anything of the bituminous structure, or the paving art for bituminous structures. He is also asked about this extract from "Scientific American Supplement No. 993," January 11, 1895, an article by Ran-

(Testimony of A. E. Schutte.)

som, put in evidence by the defendant, and witness stated that is also a Portland cement structure. Practically the same thing as the other. Counsel also refers to specifications number 62 for street paving with asphalt cement and broken stone base with asphalt wearing surface, put in evidence by defendant and referred to in this case as the Los Angeles specifications, and witness stated he was familiar with that specification. That was in evidence in the Owosso [1228—668] case. These specifications are for a sheet asphalt pavement laid upon an asphalt concrete base, the wearing surface being composed of fine asphalt cement, twelve to fourteen per cent, sand 78 to 71 per cent, and powdered carbonate of lime or mineral dust, 10 to 15 per cent. The wearing surface was not less than two inches in thickness after rolling—laid upon an asphaltic concrete, which is composed of broken stone with enough sand to fill the voids, laid at 300 degrees Fahrenheit to a thickness of six inches. The base is a broken stone the voids of which are filled with sand. The broken rock shall be clean hard rock, rough and cubical in shape, with angular edges, and ranging from the size of pea, minimum, to the largest size which will pass through a one inch ring, maximum, the voids of which are filled with sand, with clean sharp river sand, free from clay and loam, so that the aggregate will be composed of rock from an inch to pea size, which is probably about a quarter filled with coarse sand—clean sand usually means

(Testimony of A. E. Schutte.)

coarse sand, without any fine particles in it. This is mixed and laid as a base. They are similar as the base laid around Denver, very similar to that sort of base; something like this base over here—referring to the Denver alley base. Counsel asks witness to read the extract from the report of the Commissioners of the District of Columbia, dated August 16, 1895, put in evidence by the defendant, and state what he has to say of the last two paragraphs and witness stated the paragraph referring to sheet asphalt pavements refers to a change that was being made in the sheet asphalt pavement by adding fine sand, sand finer than formerly used, and recommends that finer sand should be used in the wearing surface. [1229—669]

Q. By the way, does the literature of the art with which you are familiar show whether or not these coal-tar pavements at Washington, such as those laid in Vermont Avenue and Pennsylvania Avenue and these other places, or the Scharf patent, were regarded as successful or not?

A. No, they were not. You will find numerous reference in various books, and one book which was referred to in this case, I brought with me just a paragraph regarding it.

Q. Let's see what that is? What book is that?

A. It is Love—I got it from the library here—Love on "Pavements and Roadways." On page—

Mr. LILJEQVIST.—(Interrupting.) Objected to as incompetent, irrelevant and immaterial, and hearsay.

(Testimony of A. E. Schutte.)

A. On page 118—

Mr. LYMAN.—(Interrupting.) What does that read like?

A. It says, "The effect of all of them laid—"

Q. (Interrupting.) What about?

A. It refers to Washington pavements.

Mr. LYMAN.—Let me see it just a minute.

Mr. LILJEQVIST.—I object as incompetent, irrelevant and immaterial and hearsay, and no evidence showing that the author is familiar with the character and class of pavements.

The COURT.—It is part of the literature of the time, I assume?

Mr. LYMAN.—At the time, yes.

A. "The effect of all of them laid with tar, which contained volatile matter which dried under the influence of the sun and left the pavement a mass of dry black powder"—that is with reference here to the Washington pavement laid in 1871, page 118. [1230—670]

He has another reference to that—Mr. Tilson speaks of it. Witness hasn't the book. He can look it up and refer to the references cited, but he hasn't the book. He tried to find it in the library. With reference to the other extract from the District of Columbia Commissioners' report for the year ending 1900, which has been put in evidence by the defendant, witness stated it starts with binder stone and recommends that to the stone, to the binder stone, be added a coarse material screened from the wearing surface sand—

(Testimony of A. E. Schutte.)

that is, material which is coarser than a ten-mesh screen—so as to obtain a rough compact binder which will have, after wearing, a honeycomb surface; then points out that it is a mistaken idea to have the binder stone screened too clean, and recommends that some fine material be added to the binder. Then it says that with the binders laid with stone there will only be cement at the contact points of the stone; that with a little sand the contact area will be larger and still produce a honeycomb surface. It speaks of laying the pavement and then it speaks of the wearing surface on the third page, describing it as being two and a half inches thick; cautions about the great skill required to handle the material as laid on the streets. The wearing surface composed of asphalt and sand. He reads the description of the wearing surface as follows: "The asphalt wearing surface is made by mixing heated sand with melted asphalt cement. The sand used, as I have before mentioned, is generally composed of a mixture of two or more sands, and sometimes stone dust. This mixing is done while the sand is still moist from the bank, and can be accomplished with little care, as wet sand does not tend to [1231—671] separate. Sand of the desired composition as obtained by this mixing is then passed through a revolving heating screen," and so forth. Counsel continues the quotation—"The sand of the desired composition obtained by this mixing is then passed through revolving heating drums and heated to a tempera-

(Testimony of A. E. Schutte.)

ture of about 230 degrees, after which it takes out all material coarser than a ten mesh." Counsel refers to a quotation from a book by Codrington, on "The Maintenance of Macadamized Roads," put in evidence by the defendant. That refers to macadamized roads. Counsel for defendant stated he quoted from a part of the exhibit which was offered, from an entire chapter. A copy was offered in evidence. Mr. Schutte said he had nothing to say with reference to the quotation but the whole chapter of the book with regard to the structure of the macadam roads that he saw describes that the author has made ten or twelve analyses of roads, taking the wet road surface and separating it by washing out and cleaning out the mud and fine particles from between the stones, and he found various voids in the structure, depending on the age of the pavement. He points out that in all these the pavements mentioned were laid with stone from two to two and a half inches at the start, and at a later stage of the pavement the amount of mud and detritus in the best pavements was about 30 per cent, and pointing out that the structure changes. Good macadam road is supposed to be porous so as to let the water through, because if the water flows over the top it washes off the detritus. Water is relied upon to hold the cement together. Originally macadam roads were built of two and a quarter [1232—672] inch stone, without anything else on top, and traffic broke off small pieces and formed a thin layer on top. Subse-

(Testimony of A. E. Schutte.)

quently a French method was to lay a little blinder, a blinding coat on top, to close up the biggest spaces between, while the American method later on was to lay the two layers—one was of two and a half inches and then about one inch top—one inch stone, two inches thick, and blind it and roll it together with stone screenings, so that when the road was finished it had a fine screen surfacing over, filling the upper superficial voids of the upper structure, which structure changed all the time with traffic by attrition. Part of the particles were broken off and sifted to the bottom. The pavement becomes denser and denser, until just before it wears out it is entirely dense, that is, it fills with mud and detritus, as Codrington describes. When it becomes dense it is practically worn out, because in the first place it takes such a long time to make it dense, and when it is dense it is practically worn out; and, secondly, with the rains it would wash the detritus from the top, instead of going through the structure. There are very, very few macadamized roads built now, and if they are built now they are only as a temporary expedient to allow a subgrade to settle, or before a permanent pavement is put on. It is not classed as a permanent roadway at all any more. With reference to the testimony of Mr. Mullen regarding certain graphs which he made showing what purported to be an analogy between fine sand mixtures and the mixture covered by the Warren patent, Mr. Schutte stated he hated to

(Testimony of A. E. Schutte.)

criticize Mr. Mullen's graph, but it looks perfectly absurd [1233—673] to assume that if you enlarge all the particles that pass a two hundred mesh screen and enlarge them to the size of a quarter mesh screen, that they will be the same as the Warren quarter mesh screen. In the first place, nobody knows what a two hundred mesh material is, passing the two hundred mesh; even the most accurate apparatus can't separate it, and his assumption is absolutely unfounded. Furthermore, if it is true that you can enlarge the sand and produce the bituminous structure, it also ought to be true that if you make the Warren structure smaller you should produce the sand of the asphalt structure, which is not correct—which is not a fact. Witness didn't have a plat to draw it on. If he could borrow Mr. Mullen's plat he could draw two graphs showing the diminished curve of the bitulithic pavement and the full sized curve of the sheet asphalt pavement. Mr. Mullen, furthermore, only selected such portions as suited him. He eliminated all the coarse material as not being suitable. He simply selected one special group and enlarged it one special amount of times to suit his purpose.

Adjournment.

June 5, 1922.

Testimony of A. E. SCHUTTE resumed.

By Mr. LYMAN.—I would like to offer in evidence those photographs taken by Mr. Schutte

(Testimony of A. E. Schutte.)

of certain streets in Pittsburgh, which are bound up with a copy of the contract for the paving of Dithridge Street in Pittsburgh.

Thereupon the photographs referred to and attached to the contract for the paving of Dithridge Street in Pittsburgh, were marked Plaintiff's Exhibit No. 51.

Mr. LILJEQVIST.—The photographs of Lang and Bellefield and Highland are not objected if they are in there, but the others are objected to as incompetent, irrelevant and immaterial. [1234—674]

Mr. Schutte stated he is familiar with the Averell patent that has been referred to by the defendant. He is familiar with the Ward British patent No. 13168 of 1900 referred to by the defendant.

Q. Subsequent to the trial of the Owosso case, did you make a visit to England, and on that visit did you see this patentee Ward or his works?

A. In 1906 Mr. Ward came to Boston and took out a license for laying the bitulithic pavement in England—

Mr. LILJEQVIST.—(Interrupting.) Objected to as incompetent, irrelevant and immaterial.

In 1907 witness was sent on to England to instruct them how the pavement should be laid and show them how the plant should be constructed. Witness proceeded to Ward's plant at Trowbarrow, and there saw him construct his pavements, and instructed them in the laying of the bitulithic pavements. He found that Ward's plant was

(Testimony of A. E. Schutte.)

constructed so as to produce a uniform two to two and a half inch sized stone and a uniform one-quarter inch stone or three-eighths. The screens at the plant were remarkably long, so as to produce a remarkably clean what he called three-eighths inch stone. The two inch stone—the stone was taken out of a quarry in large chunks, put through a kiln, which dried the big chunks of stone, then through a crusher, after which it was separated into this size, two and a half and one-quarter. It was then put into a mixer, which was steam jacketed, and coated with tar. It was dumped into railway cars and taken to the job and there laid, the stone being of large size covered with [1235—675] a mass of clean three-eighths and quarter-inch stone. This was laid and rolled and then covered with a layer of clean quarter-inch stone. This pavement was laid in Liverpool. Witness spent several months there. In order to lay a small sample piece of bitulithic he had to change the plant in numerous ways so as to make it possible; the mixer couldn't mix any material containing fine, on account of not being sufficiently equipped to mix it and was only capable of mixing material that contained no fine—the material was laid cold on the street. The practice of Ward was exactly as described in his patent. It wasn't a consecutive gradation of all sizes, but only two grades of stone. Mr. Schutte has examined a sawed piece of the specimen produced by defendant, Defendant's Exhibit "A–32" which purports

(Testimony of A. E. Schutte.)

to have been made under the instructions of the Averell patent 293,214. Asked whether he agrees that that sample as made, has embodied the instructions contained in this Averell patent, he said "No, I don't agree, because Averell speaks of gravel the size of a pigeon egg well screened. Now, the words 'well screened' only mean one thing; they mean well screened up to size, while in this sample a gravel pit run was used, as I understand from the witness producing the sample, being of the sizes down from inch and a half, I think he said down to a quarter inch. The pigeon egg gravel would look something like this (exhibiting a sack of small stones) some gravel I brought from Massachusetts with me, or like this (indicating and producing another sack of small stones), like gravel I picked up this morning from a street right opposite the Congress Hotel, which [1236—676] contains a few particles of broken stones, mostly gravel. I considered that box of gravel, if you exclude the broken stone, as Averell referred to, as about pigeon egg sized gravel. With this gravel he uses sand so that the combination will be gravel of these sizes and sand of the two grades, and added to this then was added from five to ten per cent of carbonate of lime under one construction. Then he says you can use sand alone if you wish, or again he says, what he calls silicious material, has been spoken of as larger than that of pigeon eggs; that when desirable, that is, for instance, when tubes or wires are to be laid quite close together the maxi-

(Testimony of A. E. Schutte.)

mum size of the coarser material is proportionately diminished; so that any uniform sized stone can be used according to Averell, or sand alone, as long as it is combined with a minimum amount of bituminous matter. He is very emphatic about the minimum amount, because his void test is made for the purpose of determining the minimum amount of bituminous matter that could be placed in it. They mention that in two places, for instance, in line 93 et seq. the percentage of voids thus ascertained in volume gives the proportionate measure, allowance being made for shrinkage in cooling, which should be used, and the silicious matter which should be done as nearly as possible to human agency, and so forth. The amount of bitumen is to be reduced to the very minimum.'' Asked if the first sack of small stones produced might be called hand-picked stones, Mr. Schutte stated it came from the beach on Cape Cod and was as near to the pigeon egg size as he could get, while these (indicating the second sack of small stones referred to) are picked right up here from the street, that [1237—677] is, with the elimination of the crushed stone between them. If you eliminate that you get the pigeon egg size.

Counsel offered in evidence the sack of small stones produced by the witness as having been picked up from a street in Portland, which was received and marked Plaintiff's Exhibit 52.

Witness stated that Averell makes the test as to the amount of bituminous material or asphalt ce-

(Testimony of A. E. Schutte.)

ment he is to use in making this conduit depend entirely upon the amount of voids that he finds in his mixture. Witness thinks this principle applied to the paving art would prove disastrous because it may give either too much or too little of bitumen. The amount of bitumen in a structure does not depend upon the voids, but upon the surface area. He has here to illustrate that a series of mixtures made with uniform grade sand, each sand having about 42 per cent of voids, and mixed these different sands and very fine gravel with a bituminous cement to show how much it takes to coat the particles as nearly as he can do it. Here is a sample composed of 4 mesh material, and in order to coat the particles it required 2.2 per cent of bitumen. The next sample is 8 mesh material, and to produce as near the same coating as he could 2.5 per cent of bitumen is used. The next is 10 mesh material and required 3 per cent of bitumen; twenty mesh material required 3½ per cent of bitumen; thirty mesh material required 4½ per cent of bitumen to produce as near as possible to coat the particles, as near as he could the same result. Forty mesh material required 7 per cent of bitumen; fifty mesh material required 8 per cent of bitumen; the voids in all these materials are exactly the same, being 42 per cent. [1238—678] Eighty mesh material required 9 per cent of bitumen. Hundred mesh material required 13 per cent of bitumen to coat the particles, while 200 mesh material, as nearly as could be made, required 19 per cent of bitumen to coat the par-

(Testimony of A. E. Schutte.)

ticles; so that, the same amount of voids being in all these materials, it required from 2.2 per cent of bitumen to 19 per cent of bitumen to coat the particles, depending on the surface area of the particles and not at all upon the amount of voids contained in the material.

Q. Just to make that more clear, is the surface area of the particles in the first of this series, the one-quarter inch material, greater or less than the surface area of the particles in the finer material?

A. It is naturally less, and as you subdivide and break up the particles it gives new areas to be covered and the finer it gets the more area is to be covered.

For instance, if you take an inch cube you have to cover six inches of area, and if you cut it in two you have to cover eight inches, and so on. The finer you break it up the more area you have to cover.

Q. Whereas, Averell makes no tests, simply the minimum amount of voids that he can get?

A. He did.

Asked how he knew that he had the particles covered to the same degree in these various samples he produced, he said by a test used in the manufacture of sheet asphalt called a pat test. It constitutes hot material of 300 degrees Fahrenheit put between two sheets of paper and patting it down, giving it six blows with the hand and [1239—679] examining the imprint it leaves on the paper; the print of the coarse particles are darker than the imprint of the finer particles because the contact is larger.

(Testimony of A. E. Schutte.)

That pat test is shown on the paper wrapping these particles. It is a well-recognized test, has been used for many, many years.

Mr. LYMAN.—Now, I wish to offer in evidence a copy of the British patent as actually—

The COURT.—(Interrupting.) Of the Averell patent?

Mr. LYMAN.—The British counterpart, Lake patent, it is a communication from Averell and Lake is the name of the patent solicitor who filed it. That is British practice.

Mr. LILJEQVIST.—Objected to for the reason that it doesn't alter the language of the publication which we introduced as a publication, incompetent and immaterial. We object as to the matter offered, not altering the United States patent offered in evidence nor the effect of the publication offered in evidence.

The document last above referred to was marked Plaintiff's Exhibit 53.

As to the character of gravel to be found in gravel pits, witness stated anybody who ever examined a gravel bank knows that the material is stratified; the stratification may be half an inch thick or it may be two feet thick, so that the voids of a gravel bank depends entirely on how far you go or how deep you go. The report which was produced with regard to these gravels is a report for the use of gravel for paving purposes and it is a selected gravel itself, such selection of the bank has been selected as will serve [1240—680]

(Testimony of A. E. Schutte.)

selected as will serve [1240—680] the purpose. But, even assuming that a certain cut in the gravel bank will give certain results as to mesh composition, they can't be maintained for two reasons; first, because the bank will not continue in the same way for any length of time, and secondarily a segregation takes place immediately as soon as the material falls down and the material will have to be recombined and screened out. By "segregation takes place" he means the coarse falling aside and the fine staying in the middle usually, so that any screen test, a correct screening of the gravel bank depends entirely on which section of the bank you took. The report produced by the defendant which shows the void tests of gravel, says the same thing. In the first place, these gravels contain a very peculiar gravel, in the first place they contain a lot of shells, silt, and a number of them being a calcium carbonate rather than gravel, and the report itself on page 34 says that the screen test—or "that the composition of the pebbles also vary, but not as a rule to so great an extent"; "that the estimates are only an approximation to the true character of the deposit. This is especially so in the proportion of boulders, gravel and sand, which nearly everywhere vary greatly from place to place in a body of gravel. The compositions of the pebbles also vary, but not as a rule to so great an extent. The impurities mentioned include the clay, iron oxide, lime carbonate, organic matter, etc.," and then further on in another place it describes

(Testimony of A. E. Schutte.)

as deposits get finer and finer in sand, as "west of Cornwall, in nearly every case the gravels lie in the form of narrow ridges alongside the western edge of [1241—681] large boulder clay deposits," and says, "west of Cornwall most of the gravel deposits are bouldery, but carry a sufficient proportion of stone of pebble size to differentiate them clearly from boulder clay. In depth, the proportion of sand increases gradually as far as the underlying boulder clay," showing that there is no uniformity to the bank at all; it became finer and finer as you go along. Again, on page 34, a description is made of the actual gravels, which are variously described as, for instance, No. 34, which was cited as having 6.8 per cent of voids; it says that no boulders over five inches in size; that is, they have been all screened out when tests were made. The tests are evidence that they are correct. The tests are made evidently on the material which is five inch in size, down to the fine particles, and so on. It shows the pebbles and clay and everything entered into these void tests. He is referring to the book referred to by Mr. Mullen, the bulletin—it is the report on road materials along the St. Lawrence River, from the Quebec boundary line to Cardinal, Ontario. 1920. Evidently these tests weren't known in the light of knowledge of 1920. As to the statement by some witness for the defendant that it was possible to get sand mixtures containing less than 21 per cent of voids, witness said that all the sands we tested up to 1900, the voids in the mineral aggregate of the

(Testimony of A. E. Schutte.)

asphalt pavement ran about between 30 and 32 per cent. Witness has no doubt that you probably could, with a great deal of care in the laboratory, take a sand mixture, carefully grade down the sizes and get that. He doesn't think it is practical, [1242—682] possibly it is physically possible, but not practical, in his opinion. As to the question whether the Warren patent in suit gives definite enough instructions to enable a man familiar with the paving art to construct a good pavement, witness thinks they are definite enough to one skilled in the art, and they had to be made broad in order to cover all the conditions as to atmosphere, kind of material, and so forth, to cover the whole United States. They couldn't be made more definite and cover all these different conditions. By different conditions he means temperature conditions, atmospheric conditions, the kind of material you can procure in the different localities. No one skilled in the art should have any trouble. No one that he knows of has had any trouble. With reference to the testimony of Mr. Heddle about certain tar-macadam pavements so-called in Hamilton, wherein he explained that the reason why they had all crumbled away so that he couldn't take a sample at all was that the coal tar, the "cementitious values," had evaporated out, witness states that if these pavements had been made under the principle of the Warren patent, the "cementitious values" would not have evaporated out, the cementing material would be held tight in the voids, filling them entirely and any

(Testimony of A. E. Schutte.)

evaporation that could take place would be at the surface. Warren Brothers Company used coal tar until about 1907 or thereabouts, in laying bitulithic pavements, and all of these pavements can be chopped out now and brought down without any trouble at all. That mixture must have been full of voids to allow evaporation to take place and water to seep into the structure, which would destroy the cementing body of the coal-tar. These coal-tar pavements that Warren Brothers Company [1243—683] laid are all right to-day, many miles of them.

Counsel says that the analyses of the Huber pavement samples which have been put in evidence show in connection with the quantity of 200 mesh material variations from as low, counsel thinks, as 2 per cent in some cases up as high as 6 per cent or perhaps more in other cases and witness on being asked what he had to say as to the reason for such variations stated: Stone cleaned very clean will have a small per cent of dust—even this gravel here, being washed by the rain, contains some; particles which are screened out, and in a screen test all these particles are removed, not only which were contained on the stones but also in the actual screen test some will be abraded in the form of dust. It is almost impossible to control the dust on account of dust sticking to the fine particles and which in analysis shows. Assuming that it is a windy day the wind blowing over the fine screen, over to the coarser screen, it is very apt to be thrown and sifted in the coarser material, which can't be obviated.

(Testimony of A. E. Schutte.)

Asked if the wind should be the other way whether a lot of the fine material will be thrown away, he stated anyone operating a paving plant knows it can become scored in a few minutes; it is very difficult to control the actual amount of the finer powders. It has no particular significance in the mixture itself. Witness has seen the jars here produced by Mr. Mullen. They didn't suggest anything to him except to show what segregation takes place between the coarse and the fine material. Explaining he stated a slight shaking up does that, shows how the finer works to the bottom and the coarse material comes right to the top. That is an exemplification of what takes place in the gravel bank or with other material used in the macadam road, and that is one of the reasons the engineers are so particular in using uniform sized stones for their macadam construction. [1244—684]

Cross-examination.

(By Mr. LILJEQVIST.)

Mr. Ward came to Boston before witness went to England. Mr. Warren showed Mr. Ward in Boston how bitulithic is laid; witness didn't. He supposes Mr. Ward was shown the patent. Mr. Ward took out a license at Boston. The very next year witness went to England. Mr. Warren went first and then witness went afterwards, the next spring, he thinks. When witness was there he tried to teach Mr. Ward how to lay bitulithic. Mr. Ward burned the other sizes of rock that he got from the

(Testimony of A. E. Schutte.)

rock crusher into lime; and the fine proportions were sold for fertilizer purposes to put on the fields. It is a fact he burned the inch and a half rock into lime. Witness is positive of that. Witness didn't go to Hamilton with Mr. Warren, but he was at Hamilton some time—he can't exactly tell, 1913 or '14 somewhere. Witness doesn't know that Frederick John Warren went to Hamilton and threatened to sue the city officials for infringement of his patent, nor that the city officials defied him and Mr. Warren quit. Witness doesn't know anything about that; he never heard of it. He never knew that Warren claimed the Hamilton pavement was an infringement of his patent; witness stated Mr. Warren claimed the very opposite. He is sure of it. Mr. Warren claimed that the Hamilton pavement didn't have the stability. Witness has seen Michigan Boulevard pavement. He supposes it was laid under the 1903 No. 727,505 patent. It was laid by Warren Brothers.

Q. And you know that that pavement went to pieces, too, don't you?

A. No, it didn't go to pieces; it rutted some.

Q. It had tar in it? A. Yes, it had tar. [1245—685]

Q. And became wavy all over it, didn't it?

A. No, it became wavy on certain sections.

Q. Quite a lot of it? A. Yes, I think so.

Q. And they had to burn the top and resurface the top with tar before they could make it stand up, didn't they?

A. I don't know exactly what they did.

(Testimony of A. E. Schutte.)

Q. You don't know what they did? A. No.

Q. And yet you were with them?

A. Yes, sir, but they worked in hundreds of places.

Q. You know everything about their successes, but you don't know anything about their failures, is that what you mean?

A. Yes, I know they laid Sheridan Boulevard with tar, which is one of the principal streets in Chicago.

Michigan Boulevard was not a perfect failure; it rutted some; he doesn't know how much. He doesn't know the president of the company had a big controversy with Linn White over that in the "Engineering News"; he knows of the controversy over the plans with Linn White. They resurfaced some of that street, he thinks they rolled stone on it. Doesn't know whether they used asphalt or coal-tar.

Q. In other words, they used a substitute of asphalt instead of coal-tar on Michigan Avenue?

A. I can't say from my own information about that. The pavement is there to-day, it is easy enough to examine what it was.

Q. It is an asphalt top, wasn't it?

Mr. LYMAN.—Why do you ask that? You have asked him that three times. Why do you ask it over and over again?

Mr. LILJEQVIST.—He said the pavement is there to-day and it is a good pavement. [1246—686]

A. It is a good pavement.

(Testimony of A. E. Schutte.)

Q. And it is because it was laid with asphalt instead of coal tar?

Mr. LYMAN.—I object to that; he said several times he didn't know.

The COURT.—He said he didn't know.

Mr. LILJEQVIST.—He seems to inject everything in your favor but he won't admit anything that is not.

Mr. LYMAN.—Well, I resent that too.

The COURT.—He has answered several times that he didn't know.

A. The work was in charge of another man, I don't know about it.

The amount of bitumen depends upon the surface area. Whatever materials run through different screens reuire a different amount of bitumen, as he shows by his tests.

The COURT.—That would depend on the quality of the material or the size?

A. Using the same material,—I used the same material exactly, with my asphalt,—then it depends on the size.

The COURT.—I didn't understand exactly counsel's question.

Q. (By Mr. LILJEQVIST.) It does depend on the size you say of the material?

A. Sure, because the surface area depends upon the size.

Q. It also depends upon the contour of the surface area, whether that is regular or irregular, doesn't it? [1247—686 (a)]

(Testimony of A. E. Schutte.)

A. That is what is meant by the surface area.

In other words, there is no telling from the material that is run through a plant just how much bitumen it is going to take. Witness has tried to explain the combination of materials in the Averell patent.

Q. And your interpretation of the sizes that go into that?

A. Yes, any size for the coarse bitumen size, the sand and the smaller size, and sand alone.

Q. In other words, you have got to have all these rocks of pigeon egg size, I understand?

A. I think that is what the words "well screened" means; can't mean anything else.

Q. That is your interpretation of that patent?

A. That is my interpretation.

Witness doesn't know how to take analysis of a gravel bank. The only way to do is to look at it and guess at it. He doesn't try to take an average sample; there is no possibility of taking an average sample. You might take an average sample of one side of the bank, or certain portions of a bank, but every bank has usually a coarser side and a finer side. You are very specific, in going to a gravel bank, to tell a man exactly where to get his gravel. Warren Brothers are, always, when they use gravel.

Q. Yet the Warren Brothers Company have laid many feet and yards of this purported bitulithic pavement, taking the gravel run, haven't they? Gravel bank? A. No, sir.

(Testimony of A. E. Schutte.)

Q. Haven't? A. No, sir.

Q. Done that in Portland, haven't you?

A. No, sir. It is all screened out and separated into sizes. [1248—687]

He doesn't know whether it is all used or not. Doesn't know how many screens they used. The best construction can be done with six screens, while we have constructed many miles of pavement using no screen at all at the plant, but we combined the material already screened at the crusher. Mr. Schutte doesn't know the exact wording Mr. Warren used in publications written by him, but his best construction was to use the gravel in six sizes, he thinks, or five sizes; in those first cases the crushers didn't give uniform product, but since then the crushers give an entirely different product over twenty-five years ago. Witness doesn't know if Mr. Warren claimed then it couldn't be laid under the four screens. It can be laid without any screens if each size contains the particles you want. You accommodate your pavement to the materials you have. It isn't true that this grading, so far as its practical effect is concerned, is in the patent and not in the job. Those analyses themselves speak.

Q. You say you can't get rid of the dust in a pavement? A. No, very little dust.

As a practical proposition, it is difficult to hold the dust down to 3%. Warren Bros. do it sometimes whenever they can—when they use material coming from a large crusher that is screened out

(Testimony of A. E. Schutte.)

clean. If you get more dust than the patent calls for it does not effect the stability of a pavement because the dust enters into the asphaltic cement.

It always remains as dust but it forms part of the coating medium and is absorbed by the asphaltic cement. [1249—688]

Q. It becomes a filler, doesn't it, even though it may become attached to the cement?

A. Oh, yes, there is a filler.

Q. And remains a filler?

A. There is a filler.

Q. If you had one per cent of a filler, or two per cent as a filler, or seven per cent as a filler?

A. Oh, yes, sure.

It depends on the aggregate how far you can go and not affect the stability. If the stones are in contact in position and lock and brace each other, why, quite a lot of dust can be added to it, because the dust only then fills the voids remaining. Witness doesn't know exactly what the per cent of the limit is.

Q. In other words, you can vary these percentages from one to three, from ten to forty-nine, and fifty to eighty, under any kind of a combination, and it stands up and you have got the stability covered by the patent?

A. Oh, no; no; it must be inherent stability—the interlocking, interbracing and bridging of the stones. The dust—the patent says approximately one to three per cent. Many asphalts—for instance,

(Testimony of A. E. Schutte.)

Trinidad Lake asphalt, contains about thirty per cent of that kind of dust.

If the cementing medium has dust it is included.

Q. If you have 48 per cent of rock over a quarter inch in size, do you have inherent stability?

A. Yes, I think you have if the stones have that interlocking and interbracing.

Q. If you have 90 per cent of that rock over a quarter inch in size do you have inherent stability?

A. No; I don't know where one stops and the other starts. It depends entirely on the stone. You can imagine cubical stones which fill it altogether and the voids will be very small and the interlocking is very definite and it requires very little of cementing material. [1250—689]

Q. If a pavement had been laid, subjected to traffic a great many years, and has stood up and not affected by it, and that pavement is made of a combination of asphalt and stones and sand and some dust, you would say that that pavement has inherent stability, wouldn't you?

A. No, I would like to see it first.

Q. You would like to see it?

A. Yes; the resistance may be due to the asphalt used. I have seen some sheet asphalt pavements where it had no inherent stability and where the whole weight and brunt of the traffic has been taken by the asphaltic cement, while I have seen bitulithic pavement which is all relegated to the structure itself.

Q. You said the stability may be due to the as-

(Testimony of A. E. Schutte.)

phalt. What is the least percentage of asphalt you have to have in order to get stability?

A. In what?

Q. In a combination of stone, sand and dust?

A. Oh, I don't know; depends on the combination. There are a great many combinations. If there isn't enough bitumen to prevent segregation you defeat the purpose for which you are building the pavement. The cementing medium is put in for two purposes, to waterproof the structure itself and also to prevent segregation. It has a double function.

The cementing medium does not give stability to the material; it gives stability to the sand pavement. You then depend on the asphalt entirely there. If you put too much bitumen into the interlocking structure you can float them all. [1251—690]

Q. You don't get stability then?

A. It depends entirely, again, on whatever it is. Stones can interlock by being close together, like this (illustrating), or interlock by being like that (illustrating). It depends entirely on the structure. It is difficult to say offhand.

It is difficult to say offhand without having something to judge from. If you have an asphaltic concrete with the voids in the mineral aggregate, exclusive of the bitumen, 21 per cent, and then you add a lot of bitumen in it so that the voids in the pavement are about 28 per cent, witness hardly thinks you would have inherent stability, but even

(Testimony of A. E. Schutte.)

possibly then; depends on what position the stones are, how they are. It is difficult to say anything, to assume a proposition, without having some facts. If counsel would give witness some facts he could probably answer a little more definitely.

Q. The amount of voids in your mineral aggregate has no relation to the amount of voids in your finished pavement, isn't that true? A. No, sir.

Q. You might have less than 21 per cent of voids in your mineral aggregate and put it into your cone, and yet when your pavement is laid on the street you wouldn't have, isn't that true?

A. Yes, sir; the patentee speaks of the voids in the mineral aggregate by themselves.

Q. Yes, that is, so far as the stability of your road is concerned, become operative and have effect only if they are in the pavement, and as distinguished from whether they are in the mineral aggregate or not; isn't that true?

A. Oh, no, that isn't true. [1252—691]

Q. That isn't true?

A. No, because, assuming a sand mixture with 33 per cent voids, the bitumen then takes the whole resistance, while bitulithic, the resistance is all in the mineral aggregate, and the bitumen cement on the surfaces is a water-proofing medium and to prevent segregation.

Q. And yet you claim that the voids in the pavement itself is determined—

A. (Interrupting.) No, the percentage of the voids in the aggregate as used in the pavement,

(Testimony of A. E. Schutte.)

which produced a pavement, when coated with bituminous cement, enough bituminous cement being used to fill the voids and coat the particles.

Witness went to Denver in 1909. Having read in an affidavit Blake filed either in the Creston or the Topeka case in 1909, he went to every alley and chopped out a piece of both ends of the alley. He had with him the chart of the city of Denver, which he has shown, which shows exactly what every alley is paved with even to the distance of twenty-five feet. This chart shows no difference in the whole alley, and that is the reason he chopped at one end and the other. In all the other alleys where there was any other pavement, even of twenty-five feet distance, it shows in the chart.

Q. In other words, you found that the plat was not a true plat, didn't you?

A. No, I should think that they considered the alley being paved with the same material. [1253—692]

The chart was given him by the engineer and he photographed it. It is in the city of Denver now. The engineer was either Mr. Meryweather or Mr. Hunt. They alternated back and forth there several years. Witness doesn't know which was the chief at the time.

Q. You didn't ask Meryweather about it? Why didn't you ask Meryweather whether there was any official plat like this?

A. This plat was in the other case.

It has been attached to one of the affidavits in the

(Testimony of A. E. Schutte.)

other case. He has used that plat for the last ten years, he guesses.

Q. Don't you know, as a matter of fact, there is no official plat of the city of Denver like this?

A. This is a photograph of a chart given me by the city engineer of Denver. It was a tracing cloth chart which I photographed.

The plat is marked as made in 1895. It says "Pavement, alleys, to date, June 1, 1895." Don't know who made this chart. It was given to him by the officials whom he thought were the competent officials to supply this information. Did not think it was necessary to get a certified copy of this map. He simply examined the map himself, had it photographed, checked the photograph and produced the map in various cases.

Q. Did you ever try to get this certified for use in any trial?

A. No, I didn't attempt to, because I was the best witness. I thought I was the best authority, having seen both of them. [1254—693]

Q. In other words, you are giving a photograph of something that you claim to exist?

A. Absolutely know to exist at the time it was photographed.

Q. You haven't got a certified copy of that map, anyway, have you?

A. No, except the photographs that were taken. I have some smaller photographs of the same thing, taken at the same time.

(Testimony of A. E. Schutte.)

Witness don't know who made it. It was given him by the city officials of Denver at the time. He went on this alley back of McGovern's place a year or so afterwards and found that there was an alley that did not show on this map. He found what is represented here, what is shown here as McGovern alley. The first time he went he had a chart which showed exactly when laid, each pavement, and he chopped out a piece at the end of each alley. The alleys are notoriously dirty. Some places you couldn't see the pavement and some places you could. 1909 was the first time he examined the alleys; he didn't chop any of the McGovern pavement out in 1909. He didn't find this pavement then. In 1910 he went back and did find it. He tried to take a sample at the lower end. He thinks they had a small piece at the time. It fell apart. He is referring to the McGovern part. He had the exact location and went down there, had the alley washed and cleaned and took a sample. He refers to the chart. There is a box in front of McGovern's door. Then this must be Fifteenth Street; somewhere around here, at this end (indicating). [1255—694] Fifteenth Street is a couple of hundred feet beyond there; the McGovern end covers towards Fifteenth Street. He took the sample at the McGovern section of the alley towards Fifteenth Street, right about here (indicating). He was asked to mark on the photograph of this alley exactly where he cut out that sample and he stated he couldn't mark it exactly. It might have been

(Testimony of A. E. Schutte.)

right here somewhere (indicating). It was at this end (indicating); probably where this patch is now (indicating). He shouldn't be surprised that it is where the asphalt repair is now. It didn't have any asphalt repair there at that time; it fell apart where he picked it up. His sample was pavement back of McGovern's, right at his property line. The buildings show distinctly where the line is between the two.

Q. You took it exactly on the property line?

A. I am not sure, no, not exactly on the property line.

Q. Did you have a part of that specimen over the property line? A. No, I don't think so.

He hasn't that specimen here; it was filed in some case. He doesn't know which case. He filed so many of those samples he don't know which one. That must have been in 1910; he took one sample then.

Q. Well, I want it in this picture. On the right-hand corner of the picture, which would be the right-hand corner of the numbered one, one?

A. Yes, somewhere in there. [1256—695]

He couldn't tell if that repair is the repair of a hole that he took out. He thinks the hole they made was probably eighteen inches square; somethink like that. Mr. McGilvrary was with witness —he is quite sure he was—and a policeman; he thinks Mr. McGovern was there, too.

Q. Now, there was plenty of that alley left there that would not fall to pieces; isn't that true?

(Testimony of A. E. Schutte.)

A. I don't know; the whole center was gone.

The picture which he has introduced, marked Plaintiff's Exhibit 45 is a picture of the McGovern section, eight feet wide by twenty-five feet long. That (indicating) is what he took out in 1910. He doesn't think he has any of the 1910 sample. Doesn't think he has a photograph of that. He thinks he went back once more, but he wouldn't say exactly—but he chopped off another piece in 1914. That was the time he took this photograph. The place where he chopped out the sample at that time is marked on the photograph. "Sample taken by A. E. Schutte" is what he is referring to. He don't know that before that time a lot of other samples had been taken out. He don't know anything about that. On being asked in reference to the long strip of repairs which witness marked in red, called "Asphalt repairs" shown on the photograph if that was where the sewer system had gone through the center of the alley, witness stated he did not believe there was a sewer system in the alley; there being no catch basins or anything in the alley. Witness has a photograph of the section of the alley which he offered in evidence. He has a photograph of the section which is [1257—696] adjacent to the piece he analyzed. He has produced a section of the piece he analyzed, showing the three pieces he analyzed. He analyzed the section that he cut off.

The COURT.—(Interrupting.) Just a moment; let me understand. That photograph that is in sec-

(Testimony of A. E. Schutte.)

tions, are those the sections that you actually analyzed?

A. Yes, sir, those are the sections I actually analyzed.

The COURT.—That is what I understood your testimony to be.

A. But it is part of this same piece.

The COURT.—I understand that, but we had a photograph here the other day—

A. (Interrupting.) No, this one I described (indicating a photograph). This is a small photograph (indicating). This is an exact counterpart of this (indicating). I will show you.

Mr. LILJEQVIST.—I see it. I saw that.

A. This is exactly—see there (indicating).

Q. In other words, the sample which you have offered in evidence is represented by the picture?

A. Yes.

Q. That has not been placed in evidence.

A. That has not been placed in evidence yet.

The COURT.—This is the photograph I had in mind (indicating). Now, is that a photograph of the part you actually analyzed?

A. Of the part that I actually analyzed.

The COURT.—And that is a part of this other?

A. Yes, your Honor.

The COURT.—That is my understanding. I wanted to be clear about it.

Mr. LILJEQVIST.—You have lines drawn dividing it into three sections, and also separating the bottom.

(Testimony of A. E. Schutte.)

A. It is sawed that way and put together and photographed.

Q. And did I understand you to say that you can look at this picture which has been marked Plaintiff's Exhibit 47, and state to the Court that in one of those sections there was less coarse aggregate than in others? A. Yes, indeed.

Q. By looking at it?

A. Yes, because the distances are so far between the stones that it requires very little imagination to see that they are not in contact.

Q. Did you tell us originally that sometimes a stone, you could just see the point of it in a picture, and that stone spread out behind and came in contact with a lot of other stones and you couldn't see it in the photograph?

A. Yes, but there must be another stone very close to it. The distances are so large that the stone could not possibly contact. [1258—697]

Witness is absolutely sure of that. Witness does not know whether those stones that it shows there are those points of the larger stone. If he analyzed the sample he knows the stones that are in there. Witness made four analyses. The first three analyses that he made are the analyses he made of the three sections shown on Plaintiff's Exhibit 47, exclusive of the bottom portion, which is below the red line. The fourth analysis made by Schutte showed 13.4 passing a four mesh screen, which is the analysis of that part of said specimen below the red line shown on Plaintiff's Exhibit 47. Wit-

(Testimony of A. E. Schutte.)

ness don't know anything about Waller Logan Page's analysis. Witness states he thinks from the appearance of the stone in there that the sample offered in this case as Defendant's Exhibit "G," was taken from part of the old pavement. From his observation of that alley and his photograph he would say he thinks that sample was a part of the old pavement. The sample offered in evidence as Defendant's Exhibit "K" as taken up by Blake in the year 1909 has the earmarks of the old pavement, which he supposes is a part of the old pavement. It has the same sort of stone in it, the same kind of gravel in it.

The specimen of McGovern alley produced by Mr. Schutte was thereupon marked Plaintiff's Exhibit No. 46.

The specimen marked Plaintiff's Exhibit 46 was taken out of this alley at the place marked on the photograph "Sample taken by A. E. Schutte." Asked if he said that in one of these corners where there seems to be a half inch flat depression about four and a half inches long and four inches wide was filled with a finer material at that time, [1259—698] he stated this thing continued to the edge of the sample, and in chopping it broke loose—referring to the fine portion of the top of the sample. He don't know if that was different from the rest of the pavement, because there's various areas of the pavement that showed fine, and various areas show coarse, the same as you see in these samples

(Testimony of A. E. Schutte.)

defendant has produced. Here is this surface all shattered, containing all coarse (indicating).

Q. All right, identify it by a mark.

A. "B."

And this one is smooth, "A." There are sections of this alley which are perfectly smooth and some sections which have entirely worn away. The stone has been removed entirely, broken loose and disappeared.

Q. Stones break out of the top of bitulithic, don't they? A. Sometimes.

Q. And they broke out just like they broke out of this sample taken by Blake, which has chiseled "B" on it.

A. No, I never saw anything like that.

Q. Never saw anything like that happen with bitulithic? A. No, not like that.

Q. It happened worse?

A. It is possible just like that.

Q. And that is possible when they make repairs on bitulithic and every other kind of pavement?

A. No, sir.

Q. It isn't? A. No, sir.

Q. So you selected a portion of this pavement where you found a little piece that seemed to have finer material on top, did you?

A. I selected the piece which showed both.

Q. Which showed both? A. Yes, sir.

Q. But that was not characteristic of that pavement back of McGovern's, was it?

A. It was characteristic of probably fifty per cent of the structure.

(Testimony of A. E. Schutte.)

He thinks it was in 1914 when he last saw that pavement. He has not seen that before coming to this trial.

Q. You don't know what the condition of all that portion of the original pavement which shows where these repair patches have been placed was, as to whether it resembles this sample [1260—699] you took out or the sample that Blake has brought to court, or Mr. Hall has brought to court, do you?

A. I shouldn't be a bit surprised but that by natural selection they got a section which had a lot of stones stay up or the upper part is wore out.

Witness wouldn't be a bit surprised if it had been worn out. He knows that in 1914 two-thirds of it was gone. He means two-thirds had been repaired. He knows that the center was repaired because it wore out. Asked the question whether because he found some asphalt repairs there, he concluded it had worn out, he stated no, because that is the section which got the most traffic, and the horses in the alley would go through the center, and the center naturally would wear out, and the rest of it, there is a section there, near a building, that no team can get close to on account of the hubs of the wheels and projecting things in the alley, so the traffic is all of it to the center of the alley, so the horses are all confined to the center, which wore out. He remembers when he first examined it that the center was worn badly. He thinks he has a photograph of that. It was a mud hole right in the center; in the joint—on both sides of the joint; more

(Testimony of A. E. Schutte.)

on the McGovern side. He doesn't seem to have his photograph, but defendant has one in evidence that shows the same thing. The one with the camera on it. It shows some, to a small extent. In 1909 the whole center was just a mud hole, extending about three feet or so. He thinks Defendant's Exhibit "F" shows something like that. There is a hole on [1261—700] McGovern's alley, extending some distance. It is a depression or worn out spot. Asked if that wasn't simply a depression of about a quarter of an inch, and standing water in it, he stated that may be so. It shows it wore out that much. He don't know how big it is. It extends from the center of the alley towards McGovern's side through there and there (indicating). This is McGovern's door. That condition in 1909 was very prevalent, and since then it has been repaired. He don't know what these repairs were placed for, except that extended right through on the edge of that pavement, and when he saw it it was frayed on the side, on that edge of that alley (indicating), so when he saw it next he thought it was naturally repaired. He hasn't a good picture of this deterioration of the alley which he saw. He has one picture which he will bring up after recess that shows it to a certain extent, but there was so much dirt on it that it really is deceptive. He didn't go back to the Denver Club at any time and make an analysis; he just examined the surface down there, and found the sheet asphalt top, or the same alley top. He don't know anything about the pavement laid in front of

(Testimony of A. E. Schutte.)

the Metropole Hotel; that was covered before his time.

Q. You were not in Denver at the time Blake—or Warren tried to tear up Blake's pavement between the street-car tracks? A. No, sir.

Mr. LYMAN.—You mean Blake's ballast between the street-car tracks, don't you, Mr. Attorney General?

Mr. LILJEQVIST.—You are capable of arguing your case, I guess. It will appear in the proper time.

Q. You don't know a thing about what repairs have been placed in that alley, other than the fact that you saw some sheet asphalt patches in 1914? [1262—701]

A. I know that thing usually has the whole edge so worn off and frayed that I can dig it out with a penknife.

The edge of the McGovern center of the alley, towards the center, the alley having McGovern's center. Right in the center. The alley is lower at the center, and water runs down through the center of the alley, and the edge of the McGovern pavement adjacent to the center of the alley was all rotted. You could dig it out with your knife, and subsequently, in 1914, he saw them all repaired. He therefore supposed they repaired that rotten spot. There was sheet asphalt repairs there. Counsel hands witness a picture, and witness states he has a copy of this picture. That isn't the picture he is referring to; he has one more that illustrates the

(Testimony of A. E. Schutte.)

condition of the wall. He had that picture taken, and where the "X" is on there is where he took the sample. It must have been '10 probably. Counsel probably knows from the exhibit. He doesn't think he took three samples; he took two.

Q. Well, if you took one away off towards Fifteenth Street, McGovern's, in '10, and in '14 you took one off upon the other end, which is marked upon this plat, and here is a picture with you in it and with an "X," and your affidavit—

A. (Interrupting.) No, it shows where we tried to take out a sample and we couldn't get it, right there; here is where we tried to take the sample (indicating).

Mr. LYMAN.—Identify the place on the photograph.

A. Right to the—I don't know that it shows the building line. It is here where we tried to take the sample and we couldn't get it, and then we went up here (indicating). [1263—702]

Mr. LILJEQVIST.—Give me my founain pen. Make an "X" along the edge here. That's all right —right here (indicating).

A. Right this black spot you can see just what we chopped (indicating).

Mr. LILJEQVIST.—Indicating that with an "X" in the margin of the picture. That will show. You took a sample there, did you, where the "X" is on the margin of the picture?

A. I tried to take it there.

(Testimony of A. E. Schutte.)

Q. Then your former testimony in this case that you did take one there is incorrect?

A. I think it is.

Q. Then you took one where the "X" is now?

A. It was indistinct. We tried to get it and couldn't take it, but then we went to the solid portion and took one out.

That must have been in the year 1910. The holes in the lower left-hand corner of the picture show part of the holes he referred to. It extended all the way down that section of the alley. The alley was about eighteen by eighteen, he should judge, something in there. Asked how long this door was, he stated he don't recollect, about eight feet he should judge. The other picture counsel has shows disintegration right in front of the door, which is extension of the other picture.

Q. These are all pictures which you took of the McGovern alley in 1914, are they?

A. These are some of them, yes. I took a great many more.

Q. Are these the ones— [1264—703]

Mr. LYMAN.—(Interrupting.) 1914?

A. Yes. I don't think this was taken in 1914 (indicating). This was taken in 1914 (indicating).

Q. (By Mr. LILJEQVIST.) What year was that taken (indicating)?

A. I couldn't tell you. Maybe in 1910; I am not sure; I am not positive of that. I know I took the general view in 1914, December, 1914—the detailed

(Testimony of A. E. Schutte.)

view and the general view, and I had taken numerous pictures before that.

Mr. Schutte refreshed his memory from the affidavit made on the 17th of October, 1911, and stated it must have been in 1911, then, that he took the pictures; he was there a number of times.

Q. And these pictures are a fair picture of the alley as you saw it at that time, are they?

A. Well, it shows some of the sections of it, yes.

Witness is not sure where K was taken, but it shows one of the disintegrated spots there.

Q. What you call disintegrated spots.

A. Well, obviously so.

Q. You tried to take the worst of that alley, didn't you, when you—

A. (Interrupting.) I have taken the alley, just as much as the photograph would show.

Q. I mean at the time you took these pictures you tried to take the worst you could of that alley?

A. No, I took the whole alley, with the exception of this spot right here, which the worst spot doesn't show.

Q. Not on the McGovern side, though.

A. Yes, on the McGovern side. The McGovern side runs away down below that paper—below that hole. [1265—704]

He refers to the waste paper shown in the center of the alley; goes about to the center of the alley, the center of the nine feet there. The sheet asphalt top was up to the left of the holes. There must be holes on both sides. Very little to choose from, so

(Testimony of A. E. Schutte.)

far as he could see, between one and the other side of the alley. He didn't bring any more copies because he didn't remember when the photograph was taken.

Thereupon pictures marked Schutte's Exhibit "G," Schutte's Exhibit "H," Schutte's Exhibit "J," Schutte's Exhibit "K," Schutte's Exhibit "L," Schutte's Exhibit "M," were offered and received in evidence and marked Defendant's Exhibit "A–76."

Witness took out two samples from this alley and attempted to take one out, he thinks.

In reference to the samples from Vermont Avenue, in Washington, marked Defendant's Exhibit "A–34" and Defendant's Exhibit "A–21," he thought it was impossible to make a true analysis of the part between the sheet asphalt top and the red sandstone base on account of the impossibility of knowing—for instance, wherever the stone marked "one" and the stone marked "two," one belonged to the base and the other belonged to the top; unless you cut through the stones you wouldn't know where it belongs to.

Q. When you soften it up and soften the bitumen up for the purpose of taking a sample, it all comes apart, doesn't it? [1266—705]

A. Yes, but a stone that is coated with bitumen you can't tell whether it is sandstone or piece of gravel or anything else—it simply looks like this (indicating)—any more than you can tell from the

(Testimony of A. E. Schutte.)

bottom here, or the bottom of any of the samples, what is below it. It is a physical impossibility.

Q. The sandstone base on the crushed rock, isn't it? A. Yes.

What witness calls the binder course is gravel. You can't separate it in making an analysis any more than you can tell which of these is gravel and which is crushed rock. The same thing exactly. Witness does not know how Highland Avenue, a sample of which was offered marked "Defendant's Exhibit, North Highland Avenue" was laid except from the contracts. He examined those numerous times and knows how they are, having examined them for the last ten years, he guesses. A seal coat is a coating to seal the pores or superficial voids or depressions that are in the pavement; it is another name that is commonly used for the flush coat of the Warren Brothers Company. When you refer to the seal coat or flush coating or squeegeeing, in engineering parlance, you refer to this flush coat that is referred to in Warren's patent.

Q. Now, if two of the witnesses in the Pittsburgh case who saw this paving laid, or part of it, state that that is the original paving laid, except that it had a seal coat on it, you would state that is not true, from your superficial examination in 1915, or at this time, of this sample? [1267—706]

A. The spot right under the seal you can see from the surface as laid, and, judging from the fact that I examined numerous pavements laid like that in their transitory state, that is, in their state from the

(Testimony of A. E. Schutte.)

time the surface was worn out partially, to the time entirely, as shown by my photographs, there was a top on these roads.

Schutte examined these streets in 1909, he thinks. He is quite sure it was about 1909. He does not know how they were laid in the early nineties except from the contracts he examined at the city hall in 1909. The streets had a vulcanite top. Vulcanite is the sheet asphalt containing some fine stone dust particles. Its thickness depends on the street—about 2 inches thick. You can find on the same street all thicknesses. He chopped out Lang Avenue and knows it had a two-inch surface on it. He chopped out Bellefield Avenue and knows it has a two-inch surface on it—a two-inch sheet asphalt surface, vulcanite surface, on it. Nearly every street he examined had that on at some portion of the street, and at some portion of the street it has worn down until the binder commenced to show through the cement. The specimen marked "Exhibit, Bellefield Avenue" shows one of the stages these pavements go into. The next stage is shown in his photograph of Castleman Street, where the stone commenced to show through, and some other streets where it just commenced to show through in a few little spots. You can find that condition in every street that was laid of this type, except such a street that had no travel at all on [1268—707] it, like Homewood Avenue, to the cemetery, which is a side street and had no traffic on it.

(Testimony of A. E. Schutte.)

Q. And because some of these streets had had this two-inch top worn out in certain portions of them and a binder course beginning to show through, therefore you testify that this Highland sample had a binder course on it?

A. I am judging from the section which is on the corner under the seal, and from my examination of this pavement for the last twelve years. I have examined them numerous times.

Q. Twenty years from now, if you should go into the city of Portland and find a sheet asphalt top that has accumulated by nature and flush coat and building on top of your so-called bitulithic pavement, and the bitulithic pavement would begin to show up, you would say that that was a pavement with a sheet asphalt top, if you didn't know anything about the past history and see it, would you?

A. I don't know; I have never seen anywhere the condition which maintains in Portland. It seems to be—the atmospheric condition in Portland seems to retain the flush coat, and I don't know of any other town in the United States that I have seen that same condition, and I can't even explain it, except due to the fact that the nights are cold here and it rains so often that the fine flush coat is not ground up to dust and ground away, but stays in place. That is the only way I can explain the condition on the Portland streets. I have never seen it anywhere else. Usually it wears to a mosaic inside of a very short time.

(Testimony of A. E. Schutte.)

Warren Bros., in 1901, at their plant at Cambridge, had various kinds of [1269—708] screens. Their engineer was designing screens at that time of various kinds. In fact, he patented a screen of his design.

Q. Did you have them in holes or otherwise?

A. He had holes in all of them.

The laboratory screens were holes up to a quarter. Witness went to the shop and had a piece of tin perforated with the exact size holes and used them for screens. The rest of the screens were wire screens; the little standard screens, from an eighth down to two hundred—wire mesh screens. Referring to Plaintiff's Exhibit 43, a cross is marked on the pavement where he took the two samples. He took them nowhere else. He took these samples in 1909. He is standing on the top. It is worn off between there. Here is the same view. The other is a photograph of the alley where he was trying to take out a piece of the same construction that shattered to pieces—or another alley, and even of the McGovern alley, two blocks further down. Neither of these were near where the paving plant of Blake was located. Blake's plant was on the other side of the station, at the other end. It would be somewhere around there (indicating) just across—this is the station here (indicating). The gas house was there (indicating). These samples were taken right there (indicating). (Witness was handed a map.) It is a larger print of the same thing. Here is the station, and there is Eighteenth Street

(Testimony of A. E. Schutte.)

(indicating), and these were taken between Sixteenth and Wazee, and this is Wewaata (indicating), this is Wynkoop (indicating). Wewaata and Sixteenth Street. It is right down Fifteenth, [1270—709] Sixteenth—it is right here (indicating). The tracks go right across. The gas plant was at the other end of the station, right here, somewhere (indicating). Witness indicates Wynkoop and Wewaata Streets on the photograph, so that is between those two streets. It is rather difficult to describe it, except you mention Wewaata or Wynkoop. On the opposite side of the station. The third picture is not a picture of any portion of the alley back of McGovern's. It is marked on the back as being the alley between Curtis and Arapahoe, Seventeenth and Eighteenth, which is two blocks away from McGovern. The same alley, except it extended farther up. The back of McGovern's was a one story brick building; bricks of ordinary size. The door is distorted on exhibit. He took the picture probably facing the door. Does not know whether the boards in the door were about four inches wide. Does not remember. No doubt the bricks were ordinary brick—ordinary size.

A. Of course, you realize that the nearer lenses are away from the—

Q. (Interrupting.) Oh, yes, I understand that.

A. (Continuing.) —the distortion of the camera, whether you take with a wide angle lense or—

Q. (Interrupting.) Now, let's pick up a sample

(Testimony of A. E. Schutte.)

here. I herewith show you a sample. Now, if you cross-section that sample in the center and analyze —or look at the right-hand side of it, and also the left-hand side of it, you find practically all the coarse rock is on the left-hand side, don't you? [1271—710]

A. No, I don't.

Q. Big rock? A. No, I don't.

Q. You don't see that?

A. No, we find one big rock in the middle, otherwise you are right, yes.

Q. You would say from looking at that rock and seeing the small rock there that there are no big rock back of it?

A. It depends on what you call big. None like that in the background, no.

Q. None of them are?

A. None like that,—at least in the immediate neighborhood. There may be, one or one and a half inches away from it.

Q. Then from looking at this sample you would say that the bigger rock are on the left hand side of that sample, wouldn't you?

A. No, I don't think I would say that. I think they are quite uniform, with the exception of this rock.

Q. Oh, you would say that there are no big rocks in that? A. Oh, yes, you can see them.

Q. You can see them? A. Yes.

Q. But you couldn't see them in the other sample? A. Which other sample?

(Testimony of A. E. Schutte.)

Q. The one you testified to from McGovern's alley, which you took?

A. Yes, I saw rocks of all kinds in it. In some spots they were close and in some they were not so close. [1272—711]

Q. And yet you can tell from that sample, you can tell by looking at it—

A. (Interrupting.) Yes, and if you will allow me to warm it up I can prove it, down to sand—

Q. (Interrupting.) You can tell by this sample which I hold before you that there are big rocks and small rocks behind what you can see?

A. I don't know what you call big and small. I would find probably fifty per cent of coarser than a quarter in this sample, and there is one big stone right in the middle of that.

Q. You don't know whether there are any big rocks back of that or not, do you? A. No.

Q. Can't tell. Now, the exhibit I was handing you and referring to is Defendant's Exhibit "A–24," is it not?

A. "A–34," you mean—it is—one thirty-four—oh.

Q. I mean the mark; it that "A–24"?

A. Yes.

Q. It has burned on it "134."

A. Yes, burned on it "134."

Counsel for plaintiff offered in evidence the specimens produced by the witness as illustrating the different quantities of bitumen necessary to coat the surfaces of different sized mineral aggre-

(Testimony of George C. Warren.)

gate, which were received and marked Plaintiff's Exhibit 54. [1273—712]

Testimony of George C. Warren, for Plaintiff (In Rebuttal).

GEORGE C. WARREN was thereupon called as a witness in rebuttal, and, having been previously sworn, testified as follows:

Direct Examination.

(By Mr. LYMAN.)

Witness is the same George C. Warren who has previously testified in this case. Counsel refers to the testimony of Mr. Heddle, for the defendant, that Mr. Fred J. Warren at one time inspected the tar macadam where that was going on in the city of Hamilton, Ontario, and witness states he knows that he inspected the pavement in Hamilton. He don't remember to a certainty as to what year, but his belief is it was in the year 1899. Asked whether Fred J. Warren's inspection of that work had anything to do with the making of his invention and patent in suit, witness stated he can't say positively that it did, but his application for his first patent, the so-called 1901 patent, stated that he was familiar with the pavement known as tar macadam, and witness has no doubt but that he had reference to the pavement laid in Hamilton and similar pavements that had previously been laid. Witness saw the work of the laying of these so-called tar macadam pavements in Ontario, first in the year 1900, fall of 1900. Contrary to the evidence given here,

(Testimony of George C. Warren.)

to the effect that the tar used was obtained from the local gas company, the Warren Chemical and Manufacturing Company, which was at that time owned by the Barrett Manufacturing Company, the Barrett Manufacturing [1274—713] Company being then and still being recognized as the leaders in the manufacture of coal tar materials, had a contract for a considerable quantity, and was furnishing a coal tar cement to the city of Hamilton for laying these tar macadam roads. Witness was asked by the manager of the company to go to Hamilton and examine the pavements carefully and give that company his advice as to the desirability of the construction and its costs, and whether or not in his judgment they could establish a business of selling their coal-tar product for the manufacture of such roads generally. Witness was met there by Mr. C. P. Rottey, who was a representative of the Warren Chemical and Manufacturing Company. He introduced witness to Mr. Wyndgate, the then city engineer. Mr. Wyndgate talked very freely about the work they were doing. He handed witness a copy of specifications, which have been put in evidence here, dated in the year 1900, under which the work was being done, and gave witness every facility for going over the work, which was under construction and under traffic. Witness saw streets actually being laid with this tar macadam. They were first laid with a foundation course about six inches in depth of stone ranging, he should say, from about four to six inches,

(Testimony of George C. Warren.)

hand broken stone, uncoated with bituminous materials and compressed with a steam roller. Over this there was laid another course of hand broken or somewhat smaller stones, in general ranging from about two and a half to three inch size, possibly down as low as two inch, which had been coated with a tar material, and that again rolled. Over that was laid a third layer of still finer stone, this being stone [1275—714] produced by a crusher, ranging in size from approximately two inches down to about three-quarters of an inch, and having very large voids between the particles. That also was coated with tar and rolled—I say tar; it was manufactured tar material—and rolled. Over that was spread a layer of crushed screenings, it was called, most of which would be about one-fourth inch size down to dust, but containing some material as much as half an inch, possibly as much as three-quarters of an inch, that again rolled, and over that they sprinkled dry crusher screenings and again rolled it. Witness' description of the work that was actually done is in accordance with the specifications for the work which have been produced in evidence here and marked "Plaintiff's Exhibit 30." That is just like the specification referred to, which was handed Mr. Warren by Mr. Wyndgate himself. Counsel asks witness to look at the drawing which is included in this report of the city engineer of Hamilton for the year 1902 (Defendant's Exhibit "V"), opposite page 44, and witness states his description tallies with that draw-

(Testimony of George C. Warren.)

ing. He should say that that cross-section with the marginal notes is about as clear a description of the work as could be produced in that way. Witness, contemporaneously with his visit to Hamilton, made a report to the Warren Chemical Company as to the process that was being carried on there. And since the testimony of Mr. Heddle was given he has telegraphed to Boston for that report and received it here. Counsel hands witness a paper, which witness states is the document. Attached [1276—715] is a copy of the correspondence. The document is a carbon copy of the original report, which was retained in witness' files.

Mr. LYMAN.—We offer this report in evidence, with attached correspondence, and ask that it be marked plaintiff's exhibit, the next number.

Mr. LILJEQVIST.—Objected to as incompetent, irrelevant and immaterial, and self-serving.

The COURT.—It may be admitted, subject to that objection. The witness is testifying now to his recollection.

Mr. LYMAN.—There could not be better evidence, your Honor, of what the contemporaneous facts were.

Said document was thereupon received in evidence and marked Plaintiff's Exhibit No. 55.

Mr. LYMAN.—Now, while I am about it, Mr. Attorney General, you may put in—when you put in this report here you asked that instead of the book going in evidence you be allowed to substitute a photographic copy of certain pages, pages 44 to

58, that being Mr. Heddle's report, and I agreed to that, subject to the proposition that we could put in anything else that was material. I wish to have added for the record this statement—you will remember that Mr. Heddle's testimony was that it was not laid in accordance with the specifications, but that there was a five-inch layer, with the stone all mixed together indiscriminately, I think he said, within limits above what would pass through—what was retained on the screen. I would like to read into the record from page 37 of this book a paragraph from the report of Ernest G. [1277—716] Barrow, the city engineer and manager of the waterworks, dated Hamilton, December 22, 1902, which reads this way:

"TAR-MACADAM ROADWAYS.

"A report on the subject, written by Mr. Heddle, assistant city engineer, is printed in this report, which fully explains the subject. This class of pavement is not suitable to be used on streets having street-car tracks, but does well on residential streets and on streets of moderate traffic. The price in the past, as on Hughson street, between King and King William streets, which has now been down four years and is still in good order, was sixty-eight cents a yard. Trinidad asphalt cost $2.10 to $2.60 a yard. We have studied the tar-macadam pavements somewhat, and I still believe the plan of grading the stone in layers is better than that of mixing them in a heterogeneous mass, as I understand is done by some cities."

(Testimony of George C. Warren.)

I should like to have a photographic copy of that page to go into the record.

Mr. LILJEQVIST.—No objection. You have read it in the record. It is there now.

Mr. LYMAN.—All right.

Said extract from pamphlet entitled "Annual Report of the City Engineer of Hamilton, for 1902," was thereupon received in evidence, and photographic copy thereof when received to be marked Plaintiff's Exhibit No. 56. [1278—717]

With reference to the last quotation read of the report dated December 22, 1902, where he is distinguishing his tar macadam pavements from the plan of mixing the stone "in a heterogeneous mass, as I understand it is done by some cities," witness stated undoubtedly it refers to the work of the Warren Brothers Company which at that time had been laid in about twenty-five different cities—yes more than twenty-five—witness' brother Fred, who was the head of their company at that time, having publicly, in meetings of engineering societies, municipal boards, and engineering papers, pointed out the weaknesses of the tar macadam pavement as laid in Hamilton and the superiority of the construction which was then being developed under their patent. While that statement counsel has read did not directly refer to any particular cities, there is no doubt in witness' mind but what it refers to that discussion. Asked if that was an accurate description of the difference between the methods used at Hamilton, as witness saw them,

(Testimony of George C. Warren.)

and the method of constructing bitulithic pavements under the Warren patent, witness said the statement counsel has read from that book is a very clear description of what was done in Hamilton when he examined it in the year 1900. What was done later he don't know. It is about as clear a description of Warren's construction as could be made in the few words. As he recollects the reading there, "several grades heterogeneously mixed together, laid in one layer," that is about as clear a description of their construction as could be made in those [1279—718] few words. He was asked to tell the Court just what the difference was between the method of construction as practiced at Hamilton, as he saw it, and the method of construction disclosed in his brother's patent, and he stated the difference is that each successive layer of the wearing surface, including the intermediate course and what is referred to as the second course, that the material had very large percentage of voids, so much so that when the temporary surfacing material is worn off, as it wore off very quickly—and not only his own observation of that but Mr. Heddle has so testified—it showed a surface which was perforated with air holes and through which witness should say that water and mud would flow about as freely as it flows through a bushel basket. The Warren construction, on the other hand, sought to make a combination of coarse and fine materials with the bituminous materials so dense that water could not percolate through and would give a very

(Testimony of George C. Warren.)

much better resistance to traffic. He should say that they were about as dissimilar as two pavements could be, using in both cases the same material —that is stone and bitumen.

Q. Now, Mr. Heddle explained, as I understand him, the early falling to pieces of these pavements at Hamilton and the fact that he was unable to cut out a sample that would hold together until he could bring it, by the quantity of his material that he used, his cementitious material and the [1280—719] quantity of the stone, which he said was soft limestone. What have you to say as to that?

A. I believe that neither of those conditions had anything to do with the inability to get a sample of solid construction of the pavement some twenty years afterwards. In fact, I know that at the time the pavement was laid you could not have gotten out a sample with different particles of stone hanging together, because the particles of stone merely attached at the two points of contact, and were coated with a very soft tar, it did not have the elements of solidity at all. As to the softness of the stone, I examined that very carefully and I should say that it was a very good quality of limestone; I should call it a tough limestone. Certainly it was a character of limestone which had been used, successfully used, for years in the laying of water-bound macadam roads in and about the city of Hamilton. I am not surprised to find the sample not hang together. I am a little bit surprised that Mr. Heddle did not bring what he did find. I be-

(Testimony of George C. Warren.)

lieve what he found was stone filled with mud that had worked through the top.

As to the question of deterioration of tar, we have laid miles of pavement in different sections of the country about that period, in which coal tar as cement was used, and in one of those cases, the very first pavement we did lay, on Harvey Street, in the city of Pawtucket, which has been here referred to, has been down now for twenty-one years, and a year ago, when I inquired of the city engineer, he said it [1281—720] it had never been repaired. I have not personally examined it for two years, but it was then in as good condition as when it was laid. That was laid with coal-tar material along the lines of our then novel improved construction.

Warren Brothers gave up the use of coal tar in the year 1907, if witness correctly remembers. It may have been 1908. Asked when he first heard of this man Hodgman witness stated certainly not before 1910, and he thinks that at that time his name was referred to in some of the litigation in Kansas or Iowa. Witness' brother, Fred, died in 1905. Witness never heard of these Denver alley pavements of Blake's prior to the time when statements began to be made by Blake about there being anticipations. The first time he distinctly recollects making an investigation of the streets in the city of Pittsburgh laid with Vulcanite was in connection with the litigation which had been started in the city of Pittsburgh against Booth & Flinn, which he thinks was in 1910, he should say. Witness went

(Testimony of George C. Warren.)

over a considerable number of streets which had been reported as having been laid with Vulcanite pavement, and were referred to in that litigation as anticipations. He found that on all of the streets examined you could see on a considerable proportion of the areas a sheet asphalt surface, meaning by "sheet asphalt surface" a mixture of asphalt and sand, but in that case contained a very little quarter inch material. He should perhaps differentiate between that and other asphalt pavements by saying at that time they mixed a certain proportion of [1282—721] coal-tar material with the Trinidad asphalt that was used. In other words, instead of using petroleum residuum, which was the general custom then for softening the Trinidad asphalt, they used the coal tar material, so that the combined material in that case was a mixture of the coal tar material and Trinidad asphalt, but as to the—there were some spots in most of the pavements where you could see the stone,—stone protruding at the surface. He particularly remembers Highland avenue, because as he was going over the street his attention was called to Senator Flinn's house on the hill, Senator Flinn being the senior partner of the firm of Booth & Flinn, who were defendants in that matter, and that street in particular, he should say that the greater portion—very much of the greater portion still showed the finer mixture on the surface, although there were spots which could be found in the line of traffic

(Testimony of George C. Warren.)

which were similar to the samples that have been presented here.

Witness made an investigation of certain streets at Washington which were laid under a certain Scharf patent, 111,051. He thinks it was in the year 1908, after that matter had been presented in the Chicago litigation—it may have been in 1909, but he thinks it was 1908—he went over a considerable number of those streets, particularly centralizing attention on Highland Terrace. It was a side drive on Massachusetts Avenue, that section of Massachusetts Avenue—that one side being a side hill, and the side drive being a detour to reach the residences on top of the hill. That Highland Terrace was particularly referred to in that Chicago litigation. In the center of the street, to which [1283—722] the traffic was subjected, there were places—he thinks perhaps it is fair to say that the greater portion of the surface showed mosaic appearance and stones at the surface. On either side of that terrace or roadway it was impossible for traffic—for vehicles' wheels to come up to within a foot of the pavement, because on one side there was a vertical retaining wall and on the other side a fence, consequently the wheels of vehicles certainly could not come so near to the edge that the hubs of the vehicles would strike the wall, and all through both sides of the street there was still in existence a tar-sand mixture surface, which accords exactly with the Scharf patent, which prevailed in that case, and the specifications of the construction. Digging

(Testimony of George C. Warren.)

into the pavement, it was very evident that the soft coal tar material which was used on the surface had in part squeezed into the open binder course below, and in part had become dried up under the sun, and worn away under traffic until the only remaining fine material in the line of traffic on the greater portion of the surface was that small amount which had squeezed down into the binder stone below by the traffic conditions. At the same time that was the only street, as he recollects, to which their particular attention was directed by this claim of anticipation in Chicago, but he did examine a number of others—Massachusetts Avenue, surrounding the Thomas Circle, and several others—he has seen no documents since to refresh his recollection, and he cannot remember the names of the others, but they all had the same general conditions. Counsel calls witness' [1284—723] attention to Defendant's Exhibit "A–19," a sample of pavement taken from Pennsylvania Avenue in Washington, and asks him what the top layer, an inch and a half or thereabouts deep, appeared to be and witness stated he should say from the appearance that it is unquestionably a patch, which may have been of large or small area, at some time laid over the old pavement below. Judging from the specifications on which the pavement was laid it could not have been done at the time of the last surfacing of the regrade. It is a very customary thing in Washington, and in many other cities, to

(Testimony of George C. Warren.)

repair their old asphalt pavements at this time, and for the past few years, with mixtures of stone and bituminous material, to repair depressions and to repair cuts that have been made in the street. No doubt in witness' mind but that that is what that surface is. The very surface condition of that shows that it could not have been subjected to travel for any considerable number of years. If it had been subjected to any considerable amount of traffic it would have been roughened, and that thin surface would have been worn off. It would not have been smooth like that. He means, by a considerable number of years, a matter of perhaps twenty years. The records as to Pennsylvania Avenue and Vermont Avenue, counsel believes, show that the firm of Cranford & Hoffman, or H. L. Cranford—in one case one and in the other case the other—did the resurfacing with sheet asphalt that was done on both these pavements and asks witness if he knew either of them and Mr. Warren stated Mr. H. F. Cranford is long since [1285—724] deceased. Mr. Warren did not know him personally. He did know Mr. Cranford's brother in Brooklyn. He is acquainted with his two sons, who are still doing business and succeeded to their father's business in Washington. These two sons do business under the name of Cranford Paving Company. The Cranford Paving Company operated under license from Warren Brothers Company; paid royalty to them, in the city of Washington.

(Testimony of George C. Warren.)

Cross-examination.

(By Mr. LILJEQVIST.)

Asked what street he personally saw in Hamilton being fixed in layers, witness stated the street they were working at that day that he was there; he can't remember, unless that report shows it. He thinks it wasn't in front of the gas company's plant. He don't remember the gas company's plant being on any of those streets. Counsel hands witness Plaintiff's Exhibit No. 55, and witness states this report shows that "the streets being laid this year"—that was 1900—were James Street north from Stewart to Ferry, construction just commenced; James Street, east side only, from Hunter to Barton, just completed; York Street, from McNab to Queen, nearly completed; Main Street from McNab to John, almost half completed; East Avenue from King to Stinson, recently completed; Victoria Avenue, from Stinson to Baxter, recently completed. Undoubtedly the street or streets on which they were working the day that witness was there was either Main Street, which is here reported —or York Street, which was reported as nearly completed, and Main Street, which is reported as [1286—725] almost half completed. The other streets referred to very clearly have been completed at some recently prior date. He don't see any more direct reference to the specific street or streets that they were laying at the time that he was there. He says those were laid with a crushed rock base or hand broken rock base, and then two courses on top of

(Testimony of George C. Warren.)

that of tarred stone, before they got the screenings. His recollection cannot be erroneous. Aside from his recollection, this report, made the day after he examined the work, so shows. He could testify to that absolutely were it not for this report. He can't say that all the streets were laid the way he saw certain streets laid, except as to the appearance of the streets. He had examined James Street north, James Street south, Main Street and York Street and they were all of the same condition.

Q. You don't know, as a matter of fact, that there were a lot of those streets in Hamilton that were built with this homogeneous mass of rock and coal tar all together, and a small surface, about a half inch to three-quarters inch, on top?

A. I don't know any such thing. As far as humanly possible, I am certain in my mind that they were not so laid. My examination there was very near the close of the working season of 1900.

Q. Now, you are not willing to let the defendant in this case take the deposition of Thomas Towers, one of the officials of that city who supervised the building of those streets, are you, to prove whether you are correct or whether the [1287—726] testimony given by Mr. Heddle is correct?

Mr. LYMAN.—That is not a question for this witness to answer, if the Court please.

The COURT.—No.

Mr. LILJEQVIST.—You are unwilling, are you, as representing Warren Brothers Company, to let the defendant in this case take the deposition of

(Testimony of George C. Warren.)

Thomas Towers, who is too old to come here, to prove whether you are correct or whether Mr. Heddle is correct?

Mr. LYMAN.—Counsel is unwilling to have any further—

The COURT.—(Interrupting.) Yes, it is not for the witness to determine.

Witness don't know if later on the city of Hamilton laid pavements with this heterogeneous mixture, but if they did it was subsequent to the formal application for our first patent, and also subsequent to the discussion in engineering societies and public papers.

Q. Your company came up there and threatened to sue them for laying a kind of a pavement that Mr. Heddle has testified to, did you not?

A. Absolutely no.

Q. You are certain of that?

A. I am as certain as I could be of anything.

Q. They told you that they had been laying that pavement long before you got your patent, and you quit, isn't that true?

A. In the absence of being shown any evidence to the contrary, I should say absolutely no, but I would qualify that by [1288—727] saying that it is pretty difficult to remember everything that happened twenty-two years ago, but I could never be more surprised at anything in my life than I would be if you could show me that any such a condition ever arose.

(Testimony of George C. Warren.)

Q. You won't let us take John Tower's deposition to show, of course?

Mr. LYMAN.—Now, I—

The COURT.—(Interrupting.) Oh, never mind about that, it isn't for this witness to say what the deposition would show.

Mr. LILJEQVIST.—Your Honor, he is challenging us and we are accepting his challenge, if he—

The COURT.—(Interrupting.) Well, it is not for this witness to say what deposition shall or shall not be taken.

Witness can't say whether Mr. Schutte is a stockholder in their company. There are about a thousand stockholders, and Mr. Schutte may be one. Mr. Schutte states he is not. Witness never heard of Mr. Hodgman until in or about the year 1910. He don't think he said absolutely an affidavit that Blake filed, although he thinks it was an affidavit.

Q. You know Blake swore in those affidavits that you had seen, did you not, that Hodgman in his presence personally explained this whole thing to your brother, Frederick John Warren?

Mr. LYMAN.—What is this? You are asking Mr. Warren if he didn't know that Blake said something of that kind?

Mr. HEAD.—What the affidavit stated.

Mr. LYMAN.—I object to that question as absolutely immaterial.

The COURT.—Yes, I think it is immaterial; I think it is [1289—728] incompetent.

(Testimony of George C. Warren.)

Asked if they settled the Creston case, in which Blake filed his affidavit, witness stated in the Creston case as he remembers—he hasn't had occasion to refer to it since—the defendant, the city of Creston, followed the same course which the cities of Topeka and Emporia, Kansas, had previouly followed, of shifting their ground and saying that they were going to lay, and, as he understands, did lay, what subsequently became known as the Topeka mixture, which, when first brought to their attention, they said very promptly had no conflict with their patent. When that change was made they dismissed the case. Warren Bros. dismissed the case when they changed their specifications. He presumes Blake was still alive in those days. They dismissed the Topeka case in the same way and on the same ground. His recollection of the Denver case was that the objections were the same, and subsequent to that he never heard of Mr. Blake, that he recollects—he never heard of Mr. Blake making any effort to lay any stone mixture other than what was then known as the Topeka pavement. Asked if Mr. Blake made that same affidavit while he was still alive in other cases which they settled, Mr. Warren said he don't recollect any others. He don't recollect that they settled, without the knowledge of Mr. Roney, the attorney of Booth & Flinn, with Booth & Flinn.

Q. You settled that case, did you not, after the Court took just a part of this Denver testimony

(Testimony of George C. Warren.)

which has been submitted in this case, and refused to allow an injunction, did you not?

A. That may be.

Q. Yes.

A. But it was settled after the defendants had agreed to in the future operate under the license of our patents. [1290—729]

Mr. LYMAN.—You would settle with anybody that would take a license, would you not, Mr. Warren? A. Almost.

Q. (By Mr. LILJEQVIST.) You paid the costs in that case, though, did you not, after the Court refused to grant you an injunction, and quit?

A. I don't know as to that. The costs were immaterial, one way or the other.

Q. You settled the Indianapolis case and the Chicago case after you were refused an injunction, which refusal was based upon the fact that the judge did not believe your patent was valid, did you not?

A. The Indianapolis case involved only a matter of about three thousand square yards, and, as I recollect it, the city then abandoned further infringements, and there was not enough at issue in that case to warrant our continuing the expense of the litigation. In the Chicago case, between the period that Judge Kohlsaat had refused to grant an injunction on the basis of the samples that were brought in from Washington, and the time that we prepared our evidence to show that that was not a true sample of the pavement as laid, there was

(Testimony of George C. Warren.)

no court sitting in Chicago before whom we could make application for injunction until late in the fall; then the street was all torn up—it was one of the most prominent streets in the city, and no court in the world would grant an injunction after a street of that character was torn up and barricaded from traffic, therefore we would not prosecute an effort to secure a temporary injunction, and before the case came to trial the [1291—730] defendants, the contractor defendant in that case, the Metropolitan Construction Company, took a license and subsequently paid us large sums of money for the use of our patents in other work, and we agreed, in consideration of their taking that license and operating under our patents instead of in defiance of the patents, we agreed to make no charge for the royalty on that—that work they had done in Chicago.

He don't know if they found it cheaper to pay them royalty than fight. Warren Brothers found it very frequently cheaper to let an infringement go rather than to carry on patent litigation. Their tar pavement in Pawtucket is good to-day. He would hardly say their tar pavement on Michigan Boulevard is a failure. It was not satisfactory, by any means. Asked if they did not have to go over it within a couple of years, and tear off the surface and re-rake it and lay another top on, of different cementing material, witness states he don't know what counsel means by re-raking. They did go over the pavement with what was known as a surface

(Testimony of George C. Warren.)

heater to soften it up and enable them to take off about an inch of the surface, and over that they laid the new surface of about an inch and a half in depth, in which they did use asphalt material as the cementing medium, and that was just about the time, as he has previously testified, that they had stopped, absolutely stopped using coal-tar material at all. [1292—731]

Q. And you and Linn White then had a controversy, in which White claimed that the real reason it went to pieces was because one to three per cent of dust was not enough to give the pavement inherent stability, isn't that true?

A. I don't recollect any such controversy.

Q. You don't remember that at all? A. No.

Q. You don't remember publishing an answer to him in the "Engineering News" on December 4, 1913, at page 1145, in which you attempted to answer a long argument and statement he had read before the Engineering Society that the reason that that was a failure was because one to three per cent of dust was not enough dust to give stability to a pavement?

A. I don't recollect the details of that, but in answer to your previous question I think you were referring to a discussion with Mr. White at the time that that work was going on in Chicago. There was absolutely no discussion with him. He and our representatives worked entirely harmoniously along the line of endeavoring to correct the defects at the least possible expense.

(Testimony of George C. Warren.)

Q. And you know from his chemical analysis that he made—he may have submitted, to your recollection, that the street that showed the dust from one to three proved a failure, when you had your tar cementing material, and that in which he had put eight to ten per cent stood up; isn't that true?

A. I don't recollect that the question of one to three per cent of fine material or the use of tar, even, material had anything to do with that discussion or with the expense of clearing the street. [1293—732]

Asked how many yards of pavement were represented in the second South Board Park case that they brought in Chicago, and also against the city of Chicago—the four cases that they recently settled—Mr. Warren stated that was the difficulty; they never were able to say what the area was. They were not able to prove there was any yards. They started that case on the understanding that there was a very large yardage. It developed that most of the yardage of which they knew to be an infringement had been constructed shortly more than, he thinks, the six-year period of the statute of limitations and that about that time, therefore, most of that was ruled out because they had not brought the suit early enough, and about that time it devloped that the city of Chicago had changed their mixture, closely resembling the Topeka construction and more nearly representing the Topeka construction, and they were not able to find practically any number of actual infringements within

(Testimony of George C. Warren.)

the period that they had a legal right to proceed, therefore the case was practically dropped, and that was done during witness' absence in the Far East; he had nothing to do with the settlement. Witness was not with his brother in Denver when he lived there. He never knew of the Denver alley matter in the Owosso case—he don't remember whether it was in the New York case or not, but so far as their bringing it up, they certainly would not have brought it up; that is a matter of defense. He thinks it wasn't in the Montgomery case—thinks it was in the Pace case. His recollection is that it was in the Grand Rapids case. The record will undoubtedly show, if his recollection is wrong.

Mr. LYMAN.—I don't think this Denver matter was in any other of the reported cases except the Denver case. It was in this Topeka case which is in the record here, [1294—733] which was settled by agreement of the parties holding the patent valid, and confining the defendants to this noninfringing Topeka mix, and also—

Mr. LILJEQVIST.—(Interrupting.) A consent decree?

Mr. LYMAN.—A consent decree—and also, as you have brought out, it was in that Booth & Flinn case, and I think in the Creston case, but I think the only reported case in which it was considered, the only contested case, was in that Evans case, before Judge Dickinson.

Testimony of Walter B. Warren, for Plaintiff (In Rebuttal).

WALTER B. WARREN was thereupon recalled as a witness in rebuttal, and, having been previously sworn, testified as follows:

Direct Examination.

(By Mr. LYMAN.)

Witness testified he is the same Walter B. Warren who has previously testified in this case. Witness has heard the testimony of Mr. Dulin, who produced photographs of six or eight or more bitulithic pavements laid here in Portland, among others a photograph of the sample of pavement on Yamhill Street fifty feet east of Tenth Street, north side street, cut by Northwestern Electric Company on March 29, 1916. The sample, as to which the note says that "there was what appeared to be a sheet asphalt top on above sample," is Yamhill Street. Yamhill Street is one of the early pavements laid in Portland. Witness thinks it was laid in 1905, and that street had a Telford macadam road, that is, a macadam with large stones on the bottom, and the finer stone laid in layers on top, before [1295—734] the contract for bitulithic pavement was let. In building those streets at that period, and also at the present time, they built macadam roads with a high crown,—that is, they are rounded up higher than would be satisfactory for a hard surface pavement—and in order to resurface this macadam, or put the Warren pavement on top of this macadam, it was necessary to chop it down

(Testimony of Walter B. Warren.)

on the top, in other words, take the high crown off of it, and with a view of making a base for the pavement it was necessary to take up the center of the macadam road, throw the big stones to one side, grade up the street and put back the stone. In doing that they disturbed the solidity of the old foundation, and while it appeared as solid when they built the pavement, time and traffic wore a change in the contour of the finished pavement when laid over it, so that water stood in the center of the street; the pavement settled into the settled base, which was disturbed, and that was of variable thicknesses. In some places it would be very thin and in others the thickness of this sample here (indicating), so that, without taking up the pavement after it had subsided, the bitulithic pavement had subsided to a settled contour, the contractor under his guaranty—the pavement was laid with a ten-year guaranty—endeavored to bring back the contour to a satisfactory appearance under the city contract, and in bringing back the contour it is necessary to use a thickness of material,—he should say, a grade of stone that is consistent with the thickness to be applied, and as this was a kind of a skin proposition, in some places very fine and in other cases a little thicker, where it had settled more, this fine mixture was put over the pavement. [1296—735] It was bringing the surface to a contour that would be satisfactory to traffic. Undoubtedly this sample, which was cut out eleven years after the pavement was laid, happened to be cut at a point

(Testimony of Walter B. Warren.)

where that had been done to the center of the street, or the center from quarter to quarter. Witness has heard the testimony of some witnesses about the practice of hauling material after the construction of this bitulithic work over an area that has already been laid, before it has been compressed and the cement cooled down. Witness states it is generally the practice—in fact there are very few cases where it is not followed—of hauling the loads of hot bitulithic mixture into the work over the finished pavement. That necessitates its passing over the mixture quite often even before it is rolled at all, and it has been in witness' experience appreciated to be a defect to in any way disturb the surface to haul hot material—heavy loads over the pavement while it is during construction; it is not sufficiently injurious to offset the advantage of having the road open at all times for the public use, so that they keep the road open at all times, generally speaking, and advertise that the road can be built without making detours around the road. The mixture being hot, hotter than it ever gets by the sun's rays, probably up above two hundred degrees when it is spread, the fact that you can haul over it in that condition demonstrates that the stone has a supporting power in it independent of the asphalt, which at that temperature is liquid. [1297—736]

Asked as to the procedure when an ordinary sheet asphalt pavement is being laid, witness stated that method is not followed and he don't think it is prac-

(Testimony of Walter B. Warren.)

tical to follow that method. Sand having no or little load-sustaining quality, independent of the asphalt, the asphalt being hot when the pavement is laid it is necessary to keep off of the mixture until it has chilled and become a crust to support the traffic. If a wagon went over it in its heated condition, as he describes going over bitulithic, it would cut through almost to the stone foundation and disturb it so that it would be necessary for them to regrade the area that had been passed over that way. It is customary, in laying sheet asphalt, for the men who work the smoother and tampers who lay the pavement to wear shoes that have large soles, probably eight inches or ten inches wide, so as to distribute their weight, so it won't sink in and make a depression in the material. It is not necessary in laying a stone mixture. They walk on it and walk across it, and on almost every contract that is laid, walk right on the mixture, to look at it and examine it; don't keep off on the sidewalk; they walk right up on it, and it doesn't compress it to any degree that interferes with the proper contour after it is rolled. [1298—737]

Cross-examination.

(By Mr. LILJEQVIST.)

Witness has heard recently that the Highway Commission on the roads laid in Oregon make you detour. He didn't know they had definitely commenced. He has heard some discussion on the question. It is due to, when the pavement is new, having

(Testimony of Walter B. Warren.)

many heavy loads pass at one point over it and possibly weaken the subfoundation and push the stone down into it and the pavement into the subfoundation. It is not because of the surface being dented. It is because the whole thing goes down on the concrete, instead of having the thing being distributed by years of traffic. The Highway Commission propose to have the whole thing equally distributed, instead of having the contractor put all the loads in one place, all in one direction, when it is brand new. Witness assumes that is their point, if they have made that general rule. [1299—738]

Testimony of G. A. Jenkins, for Plaintiff (Recalled in Rebuttal).

G. A. JENKINS was thereupon recalled as a witness in rebuttal, and, having been previously sworn, testified as follows:

Direct Examination.

(By Mr. LYMAN.)

Witness testified he is the same Mr. Jenkins who has testified before in this case. Counsel has asked witness to bring into court a specimen of pavement in which a patch had been made of the character similar to this upper layer of an inch and a half on Defendant's Exhibit "A–19," the sample purporting to have come from Pennsylvania Avenue, and witness produces such a sample. It is a sample cut from Hawthorne Avenue in this city, on the north side in the intersection of East Thirty-third Street. He cut it last Saturday.

(Testimony of G. A. Jenkins.)

Q. And what is this material at the top above the sheet asphalt?

A. That is a surface repair that has been put on the old sheet asphalt pavement in the last year or so.

Mr. LYMAN.—I will ask to have that sample offered in evidence as—

Mr. LILJEQVIST.—Objected to as immaterial and remote.

The COURT.—Illustrative alone, I suppose?

Mr. LYMAN.—Yes, illustrative, that is all.

The COURT.—Illustrative alone.

Mr. LYMAN.—Offer that as Plaintiff's next number.

Said sample so offered was thereupon received in evidence and marked Plaintiff's Exhibit No. 57. [1300—739]

Q. (By Mr. LYMAN.) I also asked you, Mr. Jenkins, to prepare a summary of the analysis of daily samples received by your laboratory from the Huber work on the contract—on the pavement from Ashland to Green Springs Mountain Road.

The COURT.—From Ashland to Green Springs Mountain Road?

Mr. LYMAN.—From Ashland to Green Springs Mountain Road, on the Pacific Highway, and on the Salem-Dallas job. Have you produced those?

A. Yes, I have.

Q. These are merely summaries taken by you from your laboratory sheets which are in your regular files? A. They are.

Q. And are analyses of daily samples?

(Testimony of G. A. Jenkins.)

A. They are.

Q. Received by you in the same manner as which you have testified regarding the stretch from Green Springs Mountain Road to the California line.

A. Yes, they are.

Mr. LYMAN.—I offer these in evidence.

Mr. LILJEQVIST.—Objected to as not proper rebuttal evidence at this time. That is part of their opening case, if anything.

The COURT.—Well, they will be admitted.

Said summaries of analyses covering Ashland to Green Springs Mountain Road and Salem-Dalles Road, were thereupon received in evidence and respectively marked Plaintiff's Exhibit No. 58, and Plaintiff's Exhibit No. 59. [1301—740]

Cross-examination.

(By Mr. LILJEQVIST.)

Plaintiff's Exhibit 57 was taken out of the street. Witness took that out of an old street that was resurfaced. He doesn't know as it is the same material as is on Defendant's Exhibit "A–19." It is a repair mixture. He brought a sample in on being instructed to get a sample being repaired—where resurfacing had been applied on pavement. He don't know exactly what it is. He believes it is the repair mixture made by the municipal asphalt paving plant in this city. He has made no analysis of it. The analysis which he has offered in evidence for tabulation of Plaintiff's Exhibit 58 is the tabulation of analysis of all samples received from that

(Testimony of G. A. Jenkins.)

job as described on the front page of the tabulation, with the average of them all in the last column of the tabulation. He made one analysis to determine that column; one analysis in each column. He don't just recall what they do show; the analysis shows for itself what he found. He made one analysis for each of these samples.

Q. Is this another sample of the Greene Springs Mountain Road, or the same one which you took up and offered in court? A. I don't understand?

The COURT.—It is the daily—It is the summary of the daily analysis from the report.

Laid previous to May 5, 1920, in both cases. Witness has seen the gravel bitulithic laid.

Q. Is this sample, Defendant's Exhibit "A–54," a fair sample of what is called ordinary gravel bitulithic? [1302—741]

A. Yes, it looks like a fair sample, as far as one can tell from a visual examination.

In answer to the Court, counsel stated Defendant's Exhibit "A–54" was from the Green Springs-California line, laid by Oskar Huber.

DEFENDANT'S ADDITIONAL EVIDENCE.

Testimony of Kenneth S. Hall, for Defendant.

KENNETH S. HALL was thereupon called as a witness on behalf of defendants, and having been previously sworn, testified as follows:

(Testimony of Kenneth S. Hall.)

Direct Examination.

(By Mr. LILJEQVIST.)

KENNETH S. HALL testified that the analysis was made in his laboratory of the Metropole Hoted sample, Defendant's Exhibit "H." It was made of the base, the coarser material than the top. He measures on the sawed side of the sample the part analyzed as that about three inches down, this coarser portion at the bottom. Approximately three inches in the center, he believes, it is three there; the other end is nearly four. He analyzed the part below that. He gives the analysis as follows. This is figured with the whole pavement as 100 per cent.

Passing 1½ and retained on ½ inch.....51.2%
Passing ½ and retained on ¼ inch.....12.9%
Passing ¼ and retained on 10 mesh.....14.2%
Passing 10 and retained on 40 mesh..... 6.0%
Passing 40 and retained on 80 mesh..... 4.4%
Passing 80 and retained on 200 mesh..... 2.7%
Passing 200 mesh..... 3.1%
Bitumen 4.45%

[1303—742]

He recapitulates that as follows, figuring it on a basis of mineral aggregate of 100 per cent.

Retained on ¼ inch.....67.8%
Retained on 200 mesh.....28.9%
Passing the 200 mesh..... 3.3%
Bitumen 5.5%
Voids 15.1%

(Testimony of Kenneth S. Hall.)

He was asked to explain to the Court in reference to that analysis, what difference there would be, if any, between the cone system and the method he used and Mr. Hall stated he imagined the cone system would give a lower percentage of voids. However, you can't tell in every case; the tendency would be the cone would show a lower percentage of voids in the mineral aggregate. The lower percentage of voids in the mineral aggregate has very little to do with the voids in the pavement itself, so far as witness knows. Witness stated you may have voids, for the sake of the argument, as low as 10 per cent in just the mineral aggregate alone, the voids enters the mix and you may have sufficient asphalt in it to prop those particles so that when it is laid in the street it may have 20 per cent of voids and all the voids being filled up with asphalt.

The COURT.—In laying pavement don't you intend to regulate the amount of bitumen by the voids?

A. It is hardly regulated by voids—to tell you the truth, I think the way the majority of people regulate it is by looks, that is the way it is done in this country.

They guess at it and then they look at it in the street and if it looks all right, all right. In other words, by experimenting in [1304—743] making the mix, the man that sets the mix, if he finds he has got a little too little bitumen, he adds more, and

(Testimony of Kenneth S. Hall.)

if he has too much he takes out some for the next batch.

COMPLAINANT'S ADDITIONAL EVIDENCE.

Mr. LYMAN.—I would like to offer in evidence the briefs in the Owosso case, if your Honor please.

The COURT.—They can be used—

Mr. LILJEQVIST.—I object to that as incompetent, irrelevant and immaterial.

The COURT.—They can be used in the arguments, the questions that were raised in that case.

Mr. LYMAN.—The briefs for the plaintiff and the defendant, and ask that they be marked, complainant's brief in the Owosso case be marked plaintiff's exhibit, the next number.

Thereupon complainant's brief in the Owosso case was marked Plaintiff's Exhibit 60.

Mr. LYMAN.—And the defendant's brief in the Owosso case, Plaintiff's Exhibit 61.

Thereupon the defendant's brief in the Owosso case was marked Plaintiff's Exhibit 61.

DEFENDANT'S SURREBUTTAL EVIDENCE.

Testimony of J. R. Heddle, for Defendant (In Surrebuttal).

J. R. HEDDLE was thereupon called as a witness in surrebuttal, and having been previously sworn, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

Q. You heard Mr. Warren's testimony, have you, with reference to pavements laid at Hamilton?

(Testimony of J. R. Heddle.)

A. Yes, sir.

Q. The courses laid at Hamilton?

A. Yes. [1305—744]

Q. Will you state whether he is correct in whole or in part, and if he is correct in part, in what particular?

Mr. MONTAGUE.—That goes in under objection.

The COURT.—Hasn't this witness testified on this subject?

Mr. MONTAGUE.—Yes, he testified very much on that subject.

The COURT.—Didn't he?

Mr. LILJEQVIST.—Well, he testified generally.

The COURT.—I thought he testified the way this pavement was laid. Well, he can testify, it will take less time.

A. All the pavement that was laid in 1899 and 1902 was laid in one layer, that is, the entire stone laid in one layer. That was on Hudson Street between Haynes and King William, which is the first pavement that was ever laid of that bitulithic pavement. That was laid in two layers, or partly laid in two layers, and over that particular pavement those specifications that have been put in were written by Mr. Farrel in the first place and copied in the second place.

Q. These specifications referred to in this testimony are not the specifications referred to by you?

Mr. LYMAN.—I object to that as a leading question.

(Testimony of J. R. Heddle.)

Q. Are the specifications referred to by Mr. Warren the specifications of the pavement as laid by you?

A. They were laid exactly as I have it in that report of 1902.

Q. Now, do you know whether Warren Brothers Company later came to the city of Hamilton and threatened to sue them personally?

A. I heard that, I don't know. [1306—745]

Mr. MONTAGUE.—Now, if the Court please—

The COURT.—(Interrupting.) I think that is hearsay.

Mr. LILJEQVIST.—Take the witness.

Mr. LYMAN.—That is all.

Mr. MONTAGUE.—For the sake of the record we ask that this testimony be all stricken out, it is obviously mere repetition.

The COURT.—I don't remember; I don't recall what he testified to before.

Testimony of F. C. Blake, for Defendant (In Surrebuttal).

F. C. BLAKE was thereupon called as a witness in surrebuttal, and having been previously sworn, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

Q. (By Mr. LILJEQVIST.) Mr. Blake, I hand you herewith a photograph purporting to be a photograph of a piece of pavement 25 feet long by 8 feet wide back of McGovern's undertaking establishment in Denver, marked plaintiff's exhibit 45,

(Testimony of F. C. Blake.)

and ask you to look at it and state how that photograph taken in 1914 compares with the looks of the pavement as you saw it when you took the sample I believe in the year 1909, which has been offered in evidence.

A. It looks exactly the same as that pavement.

Q. These repair patches that Mr.—

A. (Interrupting.) There have been several repair patches.

Q. No, maybe you don't understand this whole thing.

The COURT.—That is a photograph of the entire alley? [1307—746]

Witness stated he can explain the strip through the center of the alley; that is where the telephone company put in a conduit through the street; this shows patches or replacements over the excavation. Now, that is a sandy, gravelly material there, that subsoil, and the reason witness knows this, he was in charge of the repair work, maintenance work in the year—part of the summer of 1901 when their company had a contract with the city to do the replacing in Denver. Asked when that telephone conduit was put in, he stated it was something over a year between the conduits in all of the alleys in the downtown section. That must have been during the winter of 1900 and 1901, and the following summer they were doing repair work, and due to the fact that the soil is of a gravelly nature it had caved away, away back underneath the pavement and they would have to break the pavement around in making

(Testimony of F. C. Blake.)

the replacements, many places it did break around, and back-filling the trenches they had to use water for settling it, caused the material, the gravel to settle away from underneath the pavement back for a considerable distance.

Q. Can you take the photograph of the sample which you personally removed which has been offered in evidence and then take plaintiff's map made by Schutte and locate upon that map the place where your sample was taken out?

A. I believe I can.

The COURT.—Is this it (indicating)?

A. No, it is a little hard on that— [1308—747]

The COURT.—That is what he is asking, can you locate it?

A. No, I thought he was waiting for another photograph.

The COURT.—He wants to know if you can locate it on that where you took out the sample.

A. I can't locate that door—

The WITNESS.—I took my sample out right here (indicating).

The COURT.—Was it near the McGovern line, the McGovern building? A. Yes, south.

The COURT.—Well, mark the building.

A. South, oh, I would say about around four feet.

The COURT.—The middle of the eight foot space?

A. The middle of the eight foot space, I should say, a little south.

(Testimony of F. C. Blake.)

The COURT.—You only took one sample, or one photograph? A. Yes.

Mr. LYMAN.—You offered in evidence the picture of it?

The COURT.—He remembers it without that. This represents the door (indicating).

A. The section that I took from was right in here. (Indicating a place on a large photograph.)

Q. (By Mr. LILJEQVIST.) Marked what on the map?

Mr. LYMAN.—It says, "Section—"

Mr. SCHUTTE.—"Section still coated with fine sand mixture."

Mr. LYMAN.—The section coated with fine sand.

The COURT.—When was your sample taken, Mr. Blake? A. On September 20, 1909. [1309—748]

Mr. LYMAN.—That was before this map was made.

The COURT.—Before this map was made.

Mr. LILJEQVIST.—We have that in the record.

The COURT.—He identified it anyway.

Asked if he could state from his knowledge of that alley whether these repair patches shown are places where the pavement went to pieces or are they repairs where samples have been taken out, Mr. Blake stated it is very evident that the places that show repairs were where samples had been removed.

Q. Now, plaintiff has offered in evidence a sample marked Plaintiff's Exhibit 46, upon one end of

(Testimony of F. C. Blake.)

which is a depression about—nearly half an inch, which he claims is covered by a finer mixture. Will you state if that was covered by a finer mixture, whether this sample that you took was a fair representation of the pavement as laid in that alley as you saw it?

A. That is not representative of anything that I ever saw in that.

Q. Was there any fine mix over the top as originally laid? A. No.

The COURT.—Mr. Blake, I have forgotten how old you said you were when that alley was laid.

A. It was laid in 1892, I was between 11 and 12 years old.

Q. When was your attention first directed to the alley?

The COURT.—Well, he testified that it didn't have any wearing surface or any—I might characterize it as wearing surface. I wanted to verify how old he was. [1310—749]

A. I might say this, your Honor, that even as young as that I was, in the summertime, working on this work as a cement worker over the surface area of asphalt pavement; I worked about the plant in helping to make samples and one thing and another of that sort.

Q. (By Mr. LILJEQVIST.) When did your father first direct your attention to this McGovern alley?

A. I can't recall how long ago, I can't think of any specific time.

(Testimony of F. C. Blake.)

The COURT.—Do you remember when it was laid?

A. Yes, I remember when it was laid, because it was in the summer of the Conclave at the time that alley was laid—was the alley where we got our first steam roller. The company had never had a steam roller before.

The COURT.—What I mean, do you remember when this particular pavement in front of McGovern's place was laid, this particular eight feet wide?

A. I do, I went back there after they finished the wearing surface on the rest of it.

The COURT.—That was laid in 1892?

A. Yes, in 1892, along about the middle of the summer.

Testimony of Kenneth S. Hall, for Defendant (Recalled in Surrebuttal).

KENNETH S. HALL, being recalled as a witness in surrebuttal, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

Q. This sample of Pennsylvania Avenue that has been referred to as a patch, will you state to the Court what examination you made of the premises where that was taken from and state whether it was a patch? [1311—750]

A. Mr. Beall or Mr. Bell pointed it out to me, what was the original—

Mr. LYMAN.—(Interrupting.) Well, if your Honor please—

(Testimony of Kenneth S. Hall.)

The COURT.—(Interrupting.) Just state what you did, what you saw on the street is all.

Mr. LYMAN.—That is not the question.

The COURT.—Mr. Beall testified about that himself.

A. Well, I was trying to connect it up with what I knew about it and not what was told me.

The COURT.—Just what you know about it.

Where he took that sample was most decidedly not a patch unless it was a patch which would cover half a block. There were places in the pavement on that block that had been patched, there is no doubt about that, but as he remembers there were whole cracks running across the pavement as they do in certain pavements, over the pavements; but this place that witness cut out looked as near like the general body of the pavement as he could get.

The COURT.—Then, as I remember—perhaps I am mistaken—but as I remember that is the only sample that shows that construction.

Mr. LYMAN.—Yes, it is.

The COURT.—The only early sample.

A. The other was laid, I think the testimony shows, had been discarded, it had never been taken to the laboratory.

The COURT.—No, it had not been taken off.

Q. (By Mr. LILJEQVIST.) Now, will you state to the Court whether or not from your personal examination of the soft place of the piece of pavement you can determine what the [1312—751]

(Testimony of Kenneth S. Hall.)

mineral aggregate is behind it with reference to the sizes of the composition?

A. I should think it would be rather hard unless the mixture is absolutely homogeneous throughout.

Q. Can you state whether or not any analytic chemist can take an analysis of the McGovern alley pavement as shown by Mr. Schutte's figures or your own figures and say that that shows that the man who laid it was not laying it according to a formula?

A. I would say from the analysis that Mr. Schutte made, that appears in his testimony in the Evans case, that the way he made his analysis is contrary to all practice, laboratory practice, the idea of taking a small piece and analyzing it and then another small piece and another small piece there, now, if you would reduce that, for instance—

The COURT.—(Interrupting.) I don't understand he did that.

Mr. LILJEQVIST.—Yes, he divided it in three pieces.

The COURT.—I understand he took the one sample and divided it.

A. He sawed it into three pieces, which I would consider rather too small a sample. Now, if that were carried down to a small point so that—say, one or two hundredth grams—

Q. (Interrupting.) The photograph here shows and the testimony about the size of that sample.

A. Yes.

Q. Now, here is the sample—

The COURT.—(Interrupting.) He cut that into three pieces. [1313—752]

(Testimony of Kenneth S. Hall.)

Asked the question that if Mr. Schutte claims that he took the counterpart of Plaintiff's Exhibit 46 and drew a line along the bottom and eliminated at the bottom of it where the finer material shows on the picture and then divided the outer part into three pieces and made a separate analysis of each of those three pieces, if that is a fair way to make an analysis or proper way, Mr. Hall stated he wouldn't say that it would give a fair representative sample of the pavement. A combination of the three would, but not each one individually.

Q. (By Mr. LILJEQVIST.) From your experience in analyzing sections of pavement, will you state if you can get discordant results by doing that kind of analysis with the ordinary bitulithic?

A. It can be done, yes.

Q. Then, handing you Plaintiff's Exhibit 47, being a photograph of the counterpart of this sample offered in evidence, if Mr. Schutte claimed that he made an analysis of the different sections shown in this photograph above the red line, each of those analysis separately, will you state whether, in your judgment, that is a proper analysis of that sample?

A. The average, yes. The average result of the three would give a proper analysis, I would say.

Q. Well, now, taking Mr. Schutte's figures and his method of making the analysis, will you state whether or not any chemist or analyst or expert in paving could take the figures or the average of these figures and give analysis of the three [1314—753] samples and state that that pavement was not laid

(Testimony of Kenneth S. Hall.)

according to some predetermined plan, or whether it was a heterogeneous hit and miss proposition?

A. Well, you can't tell from one sample.

Q. From your explanation of the method that Mr. Schutte used, would you state that the conclusion which he expressed to the Court that this McGovern alley was laid without any formula or without any definite idea is a correct conclusion or not?

A. It seems to me that he has very little evidence to base it on.

Cross-examination.

(By Mr. LYMAN.)

Q. Well, do you think it was laid according to a formula, Mr. Hall?

A. According to checking up the analysis, yes, different analyses of these men and Mr. Schutte's, I believe there was one other I checked up.

Q. We have the testimony of one of the witnesses here as to how that was laid, that he took the mix and raked off the portions and left the finer materials at the bottom.

A. The testimony of the witness?

Q. Yes; that doesn't look very much like they were laid according to formula, does it? A. No. [1315—754]

Redirect Examination.

(By Mr. LILJEQVIST.)

Q. Do you know how the mixing man in the asphalt plant knows how the street asphalt is laid?

A. I don't.

(Testimony of A. E. Schutte.)

Mr. LILJEQVIST.—We offer the two Blake affidavits, F. O. Blake, filed in the other case as part of the defendant's case for all purposes.

Mr. MONTAGUE.—If your Honor please, we object—

The COURT.—(Interrupting.) The objection is well taken. You can't make evidence in this case that way.

Mr. LILJEQVIST.—We save an exception.

Testimony of A. E. Schutte, for Plaintiff (Recalled).

A. E. SCHUTTE, being recalled as a witness on behalf of plaintiff, and having been previously sworn, testified as follows:

Direct Examination.

(By Mr. LYMAN.)

Q. Mr. Schutte, some criticism has been made of your separating this sample of the McGovern alley which you analyzed into three pieces and taking the separate results of those three as evidence that it was not laid according to any formula or design. What have you to say as to that?

A. It showed exactly the way the pavement was in that specimen, showing there was no uniformity in one spot or another spot, one spot was more and the other less, the coarse material.

Q. What about the size of the samples when you divided that piece of yours into three parts, does that make a part of a size such as you would ordinarily use for analysis? [1316—755]

(Testimony of A. E. Schutte.)

A. A great deal more, a thousand grams, about two pounds and a half, when I cut that sample from which the photograph is made two or three times as much, from which I took samples and made that analysis.

Cross-examination.

(By Mr. LILJEQVIST.)

Q. If you have a small sample and you have a certain percentage of rock and a certain percentage of sand, you are not necessarily going to get in a small sample the same segregation of composition of the rocks and the sand in all your samples, are you, when you have a small sample?

A. I don't see what you mean.

Q. The smaller your sample, the greater your error is, isn't it?

A. The smaller the sample the greater it would be to one of the large pieces of stone. That is the reason why a thousand grams is always used for that sort of an analysis.

Q. In the smaller percentage of stone the greater your error would be in making your analysis, isn't that true?

A. Not necessarily, no, I don't think so.

Q. The smaller the amount of stone in your small sample, the greater your percentage of error in reference to the amount of stone in that mixture would be, isn't that true?

A. No, I don't see quite what you mean by the smaller amount of stone in the sample. A thousand grams is taken for analysis, and it doesn't

(Testimony of A. E. Schutte.)

matter whether it is large stone or a little stone, a thousand grams show the stone of the sample, whichever you analyze, unless there was only one stone in the sample, then by division you might have that stone in or out of that sample. [1317—756]

Q. In other words, if you have 48 per cent of stone laid out over a pavement, that percentage of stone in each part of the pavement won't be as uniform as it would be if you have 60 or 65 or 80 per cent of stone, would it?

A. No, they would be pretty nearly alike in those limits.

Q. How is that?

A. They are pretty nearly alike in the limits you mention.

Q. Take 75 and 35, then, for a sample.

A. Well, that 35 may be distributed uniformly or may not be.

Q. And if you have 35 per cent—

A. (Interrupting.) Exactly as it is in the Denver alley. Some places you will have 40 per cent, and some has 35 and some others has only 20. If I mix the whole thing together, of course I would get uniform results, but my analysis was made to show it was not uniform from spot to spot, that any analysis you take from that pavement would be a correct analysis of that particular spot.

Q. And that doesn't prove that it was graded at all, does it, or properly proportioned in making the mix?

A. I don't think it was graded at all; it is my

(Testimony of A. E. Schutte.)

opinion from my examination of the specimen of these samples I have here in court, proves my contention is correct.

Q. Wouldn't the raking have a great deal to do with the composition of the amount of stone that you would find in a small specimen? [1318—757]

A. Yes, if there is only a little stone and a little sand the raking will have a lot to do with it, each time the rake goes over the stone you rake out some stone. Properly mixed, there must be an excess of sand, then when the sand and stone is segregated or from which some has more stone and some less, if it is sawed it is too obvious to mention, and that is exactly what happened in the Denver alley.

Q. Then raking would have something to do with the analysis of a small section, wouldn't it, if the proportion of stone is only 35 per cent?

A. I analyzed the whole sample as I found it. He can rake all the stone in one corner and all the sand in another; I analyzed the sample as I found it in the roadway, in the alley.

Mr. LILJEQVIST.—We move, before they rest, for an order to take the deposition of Tom Powers at Hamilton, Ontario.

The COURT.—That motion will be overruled.

Mr. LILJEQVIST.—Save an exception.

Mr. LYMAN.—We should like at this time to put in our evidence on the reasonable royalty rate.

Mr. LILJEQVIST.—Now, may it please your Honor—pardon me, are you through?

Mr. LYMAN.—Go ahead, yes, I am through. [1319—758]

Mr. LILJEQVIST.—We think that we ought to dispose of this main issue first. The question of royalty is a matter of accounting, it could be referred to a master.

The COURT.—I don't think we will do that; the only question on the royalty now, the only question on that is what constitutes a reasonable royalty. You already have disclosed the number of yards and then that has become a question of fact.

Mr. LILJEQVIST.—There is a considerable amount of evidence around here, we ought to bring in the witnesses.

The COURT.—As to what constitutes a reasonable royalty?

Mr. LILJEQVIST.—No, as to the amount that they have charged to different people, the amounts have varied greatly.

The COURT.—The issue is made in this record. I don't know why you can't try it out here.

Mr. LILJEQVIST.—We would have subpoenaed witnesses upon the proposition if we had thought—

The COURT.—(Interrupting.) I thought you agreed at the opening of this trial by counsel on both sides that that question should be considered at this time.

Mr. LILJEQVIST.—Our idea was that it was to be submitted as a separate matter on an accounting by a master.

The COURT.—That was not what your associate stated, at least I didn't so understand him. Mr.

Lyman proposed at the opening of the trial that that question be heard now, and Mr. Devers, after consulting with you said that that seemed to be agreeable to the defendant. [1320—759]

Mr. DEVERS.—Your Honor, I misunderstood his question; I had the understanding that we would take care of this matter before the evidence was put in on the other and determine whether that royalty matter would be taken up now or at some other time.

The COURT.—I don't know why it couldn't be disposed of now. I don't like to hold this case up. It is not a question of accounting in the strict sense of the word, it is only a question of what constitutes a reasonable royalty.

Adjournment.

June 6, 1922.

Trial resumed.

Mr. LYMAN.—I should like, Mr. Attorney General, to arrange to have a copy of that report of Mr. George Warren's on the Hamilton operations substituted for the original, so that he can take the original with him.

Mr. LILJEQVIST.—No objection.

The COURT.—All right, that will be satisfactory. You may proceed.

Testimony of George C. Warren, for Plaintiff (Recalled).

GEORGE C. WARREN was thereupon called as a witness in behalf of the plaintiff herein, and, having previously been sworn, testified as follows:

Direct Examination.

(By Mr. LYMAN.)

Q. Mr. Warren, what do you consider a reasonable royalty under this Warren patent in suit?

A. Twenty-five cents—

Mr. LILJEQVIST.—(Interrupting.) Objected to as incompetent, irrelevant and immaterial.

A. Twenty-five cents per square yard. [1321—760]

Mr. Warren was asked to tell us reasons for that view and he stated: first, they believe that the pavement has a greater utility than any other form of monolithic which had been or has been devised. By utility he means that as shown by the results of many years they believe, mile for mile, year for year, the pavement has shown a greater durability, in the first place, and that applies to the entire country as well as Oregon and the city of Portland. It provides a superior condition as to ability to shed water or prevent the penetration of water, and a better foothold for horses. Secondarily, that is a rate which has been, so far as he knows, universally established in connection with pavement patents of high merit. Particularly, he may say that that has been established in connection with Hassam pavement, and he thinks it is

(Testimony of George C. Warren.)

also fair to say that the Hassam pavement and theirs are the only ones which he would regard as of merit that have been before the public for the past fifteen or twenty years, and as far as he can recollect, those are the only ones that have been the subject of contest. He believes that the Hassam pavement is the best type of Portland cement concrete pavement, and yet he believes that right here in Portland, where the Hassam has been the most successful of anywhere, the bitulithic, mile for mile and year for year of use, has shown the better record, and while the bitulithic pavement is still being very largely laid in Oregon and throughout the country, Hassam pavement has nearly dropped out of use—out of, he means, new construction, being laid but very little at this time.

Q. You have spoken of the value of the Warren pavement in the matter of durability, and that includes, of course, the repair item as well as replacement? [1322—761]

A. Oh, yes; and another thing along that line that I think fairly competent to answer that question, is the fact that by reason of the stability of the pavement, its wearing surface—and we have been able to show that it is practical, and Oregon states and cities principally have adopted economies of preliminary construction—particularly referring to the foundation, it being found from the first that broken stone foundation can be successfully laid, and which has not been done successfully in

(Testimony of George C. Warren.)

connection with sheet asphalt pavement, and cannot now be done successfully.

Witness means that a broken stone foundation is more inexpensive than the kind of foundation that has to be used with sheet asphalt. He means by that that the matter which has been divulged in their patent has effected actual savings in the cost of construction greater than twenty-five cents per square yard.

Q. I mean—specifically what I am asking you about is what kind of a base is used for sheet asphalt and whether that—how it compares in expense with this—

A. (Interrupting.) Portland cement concrete, —Portland cement concrete base, and that is compressed stone; the cost of cement and the extra cost of labor and manipulating the materials.

It has been for many years, and still is, the custom and found quite necessary, to secure the best results from sheet asphalt pavement, to interpose between the concrete foundation and the wearing surface a binder course of crushed stone and asphalt, which is quite unnecessary and [1323—762] is never used in connection with the bitulithic surface. The binder course itself, laid to a depth of one inch, sometimes laid to a depth of an inch and a half, but laid to the depth of one inch, would cost at least twenty to twenty-five cents per square yard. Witness thinks the price received for the Warren pavement, in general, is about the same as the price of the Hassam pavement. Bitulithic may

(Testimony of George C. Warren.)

be laid on any old macadam road; and is so laid, to the extent of many, many miles. Thirty miles of the Columbia River Highway is laid on an old macadam base. That is sometimes done with sheet asphalt construction or other types of pavement, but it is certainly not as safe and it has not proved as generally successful, as compared with bitulithic.

Q. How does your experience in the matter of charging and collecting royalties bear upon this estimate of yours of twenty-five cents, as a reasonable royalty? Please tell us your practice about that.

Mr. LILJEQVIST.—Objected to as incompetent, irrelevant and immaterial, for the reason that the defendant filed a motion and an order to compel the plaintiff to submit these books to our inspection, so we could have a chance, and the Court refused—

Mr. MONTAGUE.—(Interrupting.) Just a moment, if your Honor please. The defendant served an omnibus order directing us to produce the books and papers, and Judge Wolverton, as every court under like circumstances would have done, denied it. We assured the defendant at that time if he wanted anything specifically and knew what he wanted he would get it.

The COURT.—That has been disposed of.

Mr. LILJEQVIST.—Save an exception.

A. There has been a generally established rate of twenty-five cents per square yard. In municipalities where, either because of the requirements of the

(Testimony of George C. Warren.)

law or because of the custom of the cities themselves, they followed the practice of requiring the contractor [1324—763] or the owner of the patent to file such a royalty rate, that has been filed at twenty-five cents per square yard. As an instance of that, I refer to all of the work in the state of Louisiana, state of Indiana. I think those are the only two states letting work by public bid that they require that, with the exception of very recently in the state of Oregon. Some cities have done their own work and directly contracted with us for the use of our patents. I have particularly in mind in that category the city of Nashville, Tennessee, where we began laying pavements under our patents in 1902,—have laid pavements under that license nearly every year since, including the year 1921. During the early part, or early years, our contract with the city of Nashville was that they were to pay us sixty cents per square yard for bituminous material and license to use the patents. That sixty cents per square yard was figured on the basis of allowing twenty-five cents royalty and allowed that amount in excess of the actual cost of the bituminous material. Subsequently the city of Nashville bought its own bituminous materials on the market, and then the rate of royalty, without any other paid for supplies, was twenty-five cents per square yard. In the case of contractors, generally speaking, the license agreements which we have filed with municipalities have been on the basis of our selling the surface mix-

(Testimony of George C. Warren.)

ture prepared, ready for use, delivered hot on the wagons of the contractors, so that all contractors could lay the pavement and purchase the surface materials from us just as they would purchase from us granite blocks, asphalt blocks, brick;—it broadened the scope of competition and enabled them to [1325—764] bring in contractors which were not in the business, who would not care to equip themselves for the expensive machinery to manufacture. In those cases has been fixed a royalty and included in that practically—included twenty-five cents per square yard besides the actual cost of labor and materials and manufacture, and a reasonable—what we regard as a reasonable rate for the use of plant, for depreciation of plant and a reasonable profit in addition, for the manufacture, so that in those cases the contract yields us more than twenty-five cents per square yard. Generally speaking, when the royalty has been on a flat basis to the contractors it has been twenty-five cents per square yard. In some specific cases, where contractors have had large organizations, large equipment, which they undertook to make available to the business and to put their entire organization to a system of development of our business, and thereby reduce our expense and our troubles, we have made royalties at somewhat lower rates, sometimes twenty cents, and, in a few cases, as low as fifteen cents. I may say that here in Oregon the defendant in this case, Mr. Oskar Huber, was on that basis for a number of years, he having

(Testimony of George C. Warren.)

a large organization and a large equipment, with which he put in his best efforts in the development of the business. That was changed, however, in the year 1919, when the state of Oregon passed a law requiring the owner of the patent to file a flat royalty agreement, the same uniformly to all, and that has been filed at twenty-five cents per square yard, or he believes, in some specific cases where there have been large contracts, at twenty cents a square yard.

In this royalty of twenty-five cents that witness speaks of is included a license under any of their patents [1326—765] which the work may require or the contractor may desire to use.

Q. How did the value or importance of any other patents compare with the value or importance of this patent in suit?

A. There will be no two pavement patents covered by the same construction. The specification for bitulithic pavement requires and generally specifies a flush coat. We had a little machine, which was devised and patented by Mr. Schutte, the cost of manufacturing which was about twenty-five dollars, which effected a great economy in the spreading and uniformity—spreading of bituminous material, and that we allow the contractors to use at no charge.

Q. That is, that was—

A. (Interrupting.) In connection with their general license.

(Testimony of George C. Warren.)

Q. That was thrown in as incidental to the license under this patent? A. Yes.

Cross-examination.

(By Mr. LILJEQVIST.)

Generally speaking, Oskar Huber paid fifteen cents at all times to Warren Brothers until the legislature passed this law. Witness can't say positively that there were not some concessions made in some specific cases as to which his brother can better testify. Asked if the Warren Construction Company, which is an allied corporation of some kind with the Warren Brothers Company, paid them ten cents and eleven cents and less, witness stated he don't know what counsel refers to by "allied corporation." The [1327—766] Warren Construction Company were the pioneers in the introduction of bitulithic pavement in the state of Oregon, as in the state of Washington, and for many years took the entire expense of local development. Warren Brothers had no representative here at all. In that sense they may have been allied. Witness don't think that they have paid as low as ten or eleven cents, unless it may be in some sporadic cases. The regular royalty rate to the Warren Construction Company during those periods was the same as Oskar Huber under quite similar conditions,—that is, fifteen cents per square yard.

Q. Are you a stockholder of the Warren Construction Company?

Mr. LYMAN.—Now, just a moment, if your Honor please. I can't see how that is material, to go

(Testimony of George C. Warren.)

into the stock ownership of the Warren Construction Company, or what it has to do with this case in any way.

Mr. LILJEQVIST.—Interlocking directorate in the two corporations, we expect to show that they have paid eleven cents, or less than eleven cents, for a royalty to Warren Brothers Company,—this Warren Construction Company. It seems to me it is material.

Mr. LYMAN.—Now, if your Honor please, there seems to be no reason whatever for attempting to pry into the stock ownership of the Warren Construction Company, or its relation with Warren Brothers Company, whatever. If it—suppose it were assumed, for the purpose of this case, that Warren Brothers Company owns the Warren Construction Company outright, what difference would that make? I can't see that it would make any difference whatever if it is the purpose of his argument, [1328—767] and suits him to argue, that Warren Brothers Company owns the Warren Construction Company, let him do it, but let's not go into an extraneous matter which would lead us nowhere and take a great deal of time.

The COURT.—No, I think the objection is well taken. I think it is immaterial who owns the stock of the concern. The question is as to the reasonable royalty, what bearing it may have on that.

Mr. LILJEQVIST.—Save an exception. Does the Warren Brothers Company control,—own a

(Testimony of George C. Warren.)

majority of the stock of the Warren Construction Company?

Mr. LYMAN.—Same objection.

The COURT.—Same ruling.

Mr. LILJEQVIST.—I would like to take the answer over the—

Mr. LYMAN.—(Interrupting.) No.

The COURT.—Oh, I don't think it is necessary to do that.

Mr. LILJEQVIST.—Save an exception.

Witness don't think Mr. Hill was the representative of the Warren Construction Company in Oregon, or manager of it. Mr. Hill was for a number of years Northwest manager of the Warren Brothers Company; up to about two or three months ago. Mr. Hill held such a position in March, 1919.

Q. If in March, 1919, Mr. Hill told the State Highway Commission of the State of Oregon, in answer to an inquiry what the royalty would be upon this proposition if they laid a road under your purported patent, where there was 84,500 square yards, that the royalty would be ten thousand dollars, was he speaking on behalf of the Warren Brothers Company with authority, or not? [1329—768]

Mr. LYMAN.—Well, we will admit that Mr. Hill had authority to speak for Warren Brothers Company.

Mr. LILJEQVIST.—Do you know whether he

(Testimony of George C. Warren.)

made that proposition of ten thousand dollars royalty on the 84,500 square yards?

A. I do not.

Q. You don't know whether he made that or not?

A. No, sir.

Q. But whatever statements he made as to the royalty that the Warren Brothers Company would charge at that time were made with authority, were they not?

A. Not at all, necessarily; Mr. Hill would have no authority to make any statement of that kind unless he had received specific authority from the management of the company.

Mr. LILJEQVIST.—Well, from your knowledge of his position—

Mr. LYMAN.—(Interrupting.) Just one moment. I don't know, if your Honor please, but in view of the witness' answer I had better withdraw my admission that he had authority, I had not really inquired into it at all, but if Mr. Warren says he did not I think I will withdraw that admission and let you proceed with what further you have about that.

The COURT.—Very well.

Mr. LILJEQVIST.—I object to the withdrawal of the admission.

The COURT.—Very well.

Witness does not know whether Mr. Hill made that statement to the Highway Commission or not. If such a statement was made Mr. Warren will not state that it was authoritative. He won't state

(Testimony of George C. Warren.)

that it was not; he couldn't state either one way or the other. It is a matter entirely from memory. They haven't [1330—769] charged royalties in this country less than that to large contractors; or to a number of contractors; not with any degree of regularity. The royalty they charged to any city in the United States was not less than twenty-five cents per square yard. To any contractor, meaning by that such contractors as he has referred to, who are giving their best service, assisting in the development of their business, generally speaking not less than fifteen cents. Witness can't say that there may not have been some sporadic cases, where the contractor showed that he lost money on his work, or something of that kind, that he was made concessions; they were sporadic, and not a general proposition. Witness states he don't know that he ever heard of the Adams-Athena Highway and he has no recollection of Mr. Hill ever having been given any authority to make such statements. The United Contracting Company have laid pavements under Warren Brothers' license. Witness thinks they were charging them fifteen cents per square yard, they also being in that class of contractors. Witness hasn't any books that show what royalties were paid to him. Their books are in the city of Boston. Didn't bring them out here; in fact witness has not been in Boston for nine months. He has no records here by which he can check up or let counsel examine with reference to the amount of royalties that have ever been paid to them

(Testimony of George C. Warren.)

anywhere in the United States. His brother may [1331—770] be able to, as to some points; probably can. Witness don't know of any case where they allowed some contractors in Oregon to lay their pavement and have not charged them any royalty at all. He knows that they have laid pavement free in front of churches, and almost free in front of hospitals, and all that sort of thing. With reference to this Tillamook road that they had a lawsuit over, witness' recollection of that case is that the Court held that their patents had not been used in that case; and that in consequence of that they refunded the royalties that had already been paid. There was a royalty charged, and witness' recollection was the royalty had been paid and he thinks it was refunded, if he remembers right. Witness believes now the pavement was laid under their patents. The Court said it was not. They refunded the royalty in that case to the Warren Construction Company. He presumes it was fifteen cents a square yard, although he can't say positively. It is his recollection that they refunded the royalty to the Warren Construction Company. He never heard of any case where they allowed Huber to lay any road in which they charged him no royalty at all or refunded a royalty. If there was any such case it didn't come before witness. His brother is able to testify as to that. He knows of no other road in Oregon in which they charged a royalty and then refunded it. On the Island City-La Grande-Hot Lake section of the old Oregon

(Testimony of Walter B. Warren.)

Trail, in Union County, laid by the Warren Construction Company, witness don't know what royalty Warren Brothers charged them on that road; and he don't recollect ever having heard of the road. [1332—771]

Testimony of Walter B. Warren, for Plaintiff (Recalled).

WALTER B. WARREN was thereupon recalled as a witness in behalf of the plaintiff herein, and, having been previously sworn, testified as follows:

Direct Examination.

(By Mr. LYMAN.)

Witness agrees with his brother's view that twenty-five cents is a reasonable royalty under this patent in suit. Asked his reasons for that view he stated the remuneration that the company gets from that collection is not more than a reasonable return on the effort and energy they have put in the work in operating the business and the ordinary expenses of operating in the business, which is salesmanship and litigation and inspecting the work, keeping up the high standard, paying a fair return on the investment. Witness believes that the Warren pavement costs less to maintain than other bituminous pavements that were laid prior to this invention. His observation has been that. He for several years laid sheet asphalt pavements, and has had charge of laying Warren pavement. The repairs are very much less. They would not hesitate to guarantee their pavement for a longer

(Testimony of Walter B. Warren.)

period than they would a sheet asphalt pavement.

Q. I want to read you something from the report of the Chamber of Commerce Paving Committee, which is in evidence here as Plaintiff's Exhibit 21, speaking of the Warren pavement,—they say: "There is another point about the Warren pavement which merits attention. Your committee is of the opinion that it can be easily and cheaply repaired so that with the small maintenance cost the life of the pavement will cover the minimum period of fifteen years, as above referred to in this report." Does the Warren pavement—has it been shown that it lasts fifteen years? [1333—772]

A. Yes, sir. There are some repairs required to any pavement during the period of fifteen years, due to some causes, but beyond the control of the contractor, and often have nothing to do with the character of the wearing surface,—settlements and sub-surface drainages, and so on, that disturb the pavement as originally laid and distort it and require levelling the pavement to a proper contour. The bitulithic pavement is laid with a two inch wearing surface and a flush coat of liquid, as has been described by the witnesses, and that liquid can be re-applied at different periods in the life of the pavement and perpetuate the pavement without—the pavement being free from voids, and the oils not evaporating from the material, or they are confined, hermetically sealed, and the liquid can be poured over the top of the pavement. That is what we call a double flush coat,—one coat to dry up the

(Testimony of Walter B. Warren.)

dust on top of the pavement, and another to give a bituminous gum on the surface, and sand is thrown into it, and make on the top of the pavement a new volume about an eighth of an inch thick that would probably stay for several years before it had to be re-applied. In that way you keep the original thickness of the pavement, and it is practical to perpetuate it. That is not practical to do with the sheet asphalt pavement, which is one of the earlier pavements in use.

Q. This report goes on to say: "The ease of repair seems to be principally due to the fact that where the repair must be made by incorporating of new material it can be done by building the pavement up without having to go down to any sub-foundation." What is the fact as regards that? [1334—773]

A. That is a fact, but not an advantage as compared with sheet asphalt, because sheet asphalt can be treated similarly. It is an advantage as compared to cement or brick or wood blocks.

Q. Then the report further says: "It may be remarked that this stability presented by the Warren pavement results in the employment of a different type of foundation without violating safe practice, for in this type of pavement we think it has been demonstrated beyond successful dispute that under ordinary conditions the foundation of broken stone may be used for bitulithic or Warrenite pavement. The result of this will be to greatly reduce the cost of the Warrenite pavement on those portions of

(Testimony of Walter B. Warren.)

the county roads which require new foundations." Is that a correct statement? A. Yes, sir.

Asked what is the fact as to this saving in the cost of foundation due to the use of bitulithic surface, witness stated the strength of the wearing surface in itself, that is, of the bitulithic wearing surface, as compared with tar bituminous pavements that were in existence at the time this pavement was invented, makes it possible to lay the pavement on a base that is somewhat yielding, and the yielding of the base does not deteriorate the surface. Examples of that are all over the city, that he can refer to, in some cases where asphalt has been laid and failed, due to the base. Ladd's Addition is a prominent example, and on top of that same tar pavement bitulithic has been put. [1335—774] The weakness of the base does not impart to the surface a general weakness, except in exaggerated cases, while in sheet asphalt it is very necessary to keep the base absolutely rigid, as the wearing surface is, in effect, a crust that shatters and becomes pliable as the base under it gives and yields. As to the relative amounts of Hassam pavement and the Warrenite or bitulithic in the State of Oregon, witness wouldn't know definitely. He should say that there is possibly a tenth as much Hassam, or a fifteenth as much Hassam as bitulithic. Hassam pavement is not being laid now in the state, to witness' knowledge. There is a company here called the Oregon Hassam Company. Oregon Hassam Company are laying contracts for the bitu-

(Testimony of Walter B. Warren.)

lithic pavement under the state. They have taken several. The first contract they entered into a license contract with Warren Brothers, and Warren Brothers furnished a plant and the assistance in manufacturing the mixture to get the proper mixture, and the work was laid on one of the state highways. Since that time the Oregon Hassam Company have taken contracts with the state under the plan where the state assumed the responsibility for the patents, or at least they indicate in their contract that they will. Witness thinks the contract with Huber was laid about May, 1919. As to the royalties usually charged prior to that time by witness' company, in this district of which witness is superintendent witness stated they, generally speaking, have been twenty-five cents, although there are individual cases.

Q. I wish you would give a list of such contractors as you can remember who have paid this regular royalty rate of yours prior to this date of this contract? [1336—775]

Mr. LILJEQVIST.—Just a second. I would like to ask a preliminary question, if I may. Have you any books or records to show payments made by them here in Oregon?

A. We have some lists made up from time to time of the contracts that are awarded. We don't keep a regular set of books here. They are in Boston. We have a branch office here only.

M. LILJEQVIST.—You haven't any records

(Testimony of Walter B. Warren.)

here in Oregon showing the amount of royalties paid by anybody in Oregon?

A. We have a list of the yardages that were laid by these contractors, and, generally speaking, we have knowledge of what royalties were paid by each contractor.

Mr. LILJEQVIST.—Well, don't you have any books in which you keep that here?

A. No books; no, sir.

Mr. LILJEQVIST.—Where do you keep the books?

A. We sent a bill to the contractor and the bill is paid; the money is at the disposal of the company in the east. The books—

Mr. LYMAN.—They probably have the contracts themselves of the licensed mixture agreements.

A. We have many contracts covering that matter.

Mr. LILJEQVIST.—We object to any evidence, for the reason that the books—along this line of royalty payments, for the reason that the books are the best evidence, the books are the original entry, and for the reason that we have filed a motion to see the books and it has been refused.

The COURT.—Well, you have got that into the record once and you needn't repeat it. That has been disposed of. [1337—776]

Mr. LILJEQVIST.—I wanted to save the question by this witness.

The COURT.—All right. He may answer the question, if he knows, without reference to the

(Testimony of Walter B. Warren.)

books. If he does, he can testify to it, and that is the best evidence.

A. The contractors in the Northwest, in the section handled by our office, that have paid twenty-five cents or over—in some cases it would amount to a little more, due to the basis that we might be operating under, or at least twenty-five cents—are the Pacific Bridge Company, of Portland, James Kennedy, S. Burch & Sons, Hanlon & Oaks, Haggart Construction Company, Bartson & Son, Axton & Spratton, the State of Utah, Salt Lake County, Columbia County, Oregon, Campbell Building Company, Givens & Read, B. J. Moran, Strange-Maguire Paving Company, J. C. Maguire, Giebisch & Joplin, Ambrose & Birdsell, Western Paving Company, Arentz Construction Company, Standard Asphalt Paving Company, John Fife, Mitchell Brothers, Guy Pyle, United Contracting Company, Columbia Bitulithic Company, Kiser Paving Company. That is the list as I remember it.

Q. (By Mr. LYMAN.) I might mention one or two others, to remind you. Clark & Henery Construction Company?

A. Yes, they paid us twenty-five cents.

Q. J. W. Mellon?

A. They paid us twenty-five cents—no, Mellon paid—we collected twenty-five cents from Mellon, yes, or more.

Q. Bartson & Son?

A. Yes, I mentioned Bartson & Son.

Q. Did you mention Hanlon & Oaks?

(Testimony of Walter B. Warren.)

A. Yes. [1338—777]

Q. Now, tell us in what form—no, first, have you departed from that twenty-five cent rate in any case? A. Yes, sir.

Q. Now, in what cases? In what sort of cases?

A. Well, where—where contractors have been equipped with our plants to lay the pavement and were willing to put in their organization to assist in developing our construction and encourage the use of the pavement, go to considerable expense in connection with that, we estimated that the expense that they were being put to was an item and relieved us of some expense, and we made a charge to them of—to several of fifteen cents, others a slightly higher rate, depending on what seemed to be fair for the transaction. The fifteen cent basis that we have operated under, Oskar Huber and the Oregon Independent Paving Company, and the Warren Construction Company. In one or two cases we have made a rate of fifteen cents with the Washington Paving Company, but they have paid the higher rates, too, and several companies have paid us eighteen cents, some twenty cents, depending on the particular situations that we seemed to—seemed to make it reasonable for us to meet them, or some particular situation in assisting in securing the contract, within the estimate of money available or some limit that may be set in some states on the amount that can be assessed for pavement.

(Testimony of Walter B. Warren.)

Q. The Attorney General was asking Mr. George Warren if you ever allowed Mr. Huber to lay any pavement free, I believe. Can you answer that question? [1339—778]

A. Well, several years ago,—many years ago, there were some pavements laid in Portland around Ninth Street, small contract, that we thought that he was infringing our patents, and after an adjudication of our patent in the courts—the license was always taken out by him for laying our pavement, and, as I remember it, we did not collect on that particular small yardage; it was only a few thousand yards.

There was a contract in a cemetery near Portland that Huber had secured that Warren Brothers knew nothing about until after Huber had secured it, a small contract in the drives in the cemetery. Huber came to witness and told him that he had this contract, that he had taken it with the idea of using the Topeka mixture—that is a sand mixture with about twenty-five per cent of chips floating in suspension in the sand, and which pavement has very little stability to hold up a roller or support traffic; it makes it very difficult to lay on a weak foundation—Huber told witness that he had that contract and he couldn't properly lay the pavement, in his judgment; he had just had an experience with Mr. Theodore Wilcox in the vicinity of Portland, laying a driveway for him under specifications of the Topeka mixture, and he had had to go back and back on it and it was still unsatis-

(Testimony of Walter B. Warren.)

factory to Mr. Wilcox, and he didn't want any more experience like that, and he wanted to know if arrangements could not be made that he could use Warren Brothers' mixture on the cemetery driveway, and Huber told witness he had taken the contract without any idea of paying any royalty and there wasn't [1340—779] any price in it that could permit it—and they compromised on paying seven cents a yard, and that was the basis of that contract. A very small matter. Witness thinks it was not over four or five thousand yards. Contracts are laid under this license agreement, the contractors having no plant, and Warren Brothers would in that case manufacture the mixture for the contractor, and in the price that they would file for mixture would be included over and above the reasonable cost of construction an item for depreciation on the equipment that was used in the manufacture, and usual profit for the time and energy spent in mixing, and a charge for royalty, which they put in at twenty-five cents. Some of these contracts are let that way. Some contractors, after having gotten the contract, will want to make the mixture themselves—they are getting out the stone for the base, or they are equipped to furnish the materials that go into the wearing surface—and Warren Brothers sometimes contract with those contractors to furnish things for them in connection with the wearing surface, leaving us the bituminous cement and the royalty, to be furnished by Warren Brothers, and Warren Brothers pay them an amount that would give them the amount that War-

(Testimony of Walter B. Warren.)

ren Brothers think they would be entitled to, on that basis that witness has mentioned. That is, in such cases the difference between the price they agree to pay Warren Brothers for their mixture and cement and royalties exceeds the prices which Warren Brothers sublet, as it were, the work of making the mix which they are under obligation to do, by the amount of the royalties. The royalties plus the cost of the [1341—780] cement, the bitumen and the sand. In some cases those contracts have been let leaving Warren Brothers less than twenty-five cents, sometimes fifteen cents. They have made some with some of the contractors here, like Huber, for instance, where they do that. That is the same thing he has been telling about before. Counsel refers to the question asked of witness' brother about the United Contracting Company and witness states his brother was partly right and he was right in what he stated. The charge for the United Contracting Company would be twenty-five cents. However, Warren Brothers have made arrangements with them from time to time on some contracts that on the basis of a net fifteen, plus as an additional royalty part of their profits that they would make on the work, a sliding scale, which sometimes made more than twenty-five cents. Witness thinks his brother had in mind a condition that existed on the fifteen-cent basic price with an up scale, depending on how the contract worked out, there being some problems in the contract that seemed startling to the contractor, and that they were willing to work with him on that question and

(Testimony of Walter B. Warren.)

participate in case the serious obstacle that the contractor might see would materialize. Witness has only given counsel the names of the contractors laying pavements up to the time this law of 1919 went into effect. There are many others since that time under other conditions. Since the law went into effect which required the giving of the same terms to all—the filing of a general license contract which was applicable to all contractors, all contractors have been free to apply. There is one point that witness don't think he completely answered. Counsel asked him if Huber had paid less than fifteen cents and counsel [1342—781] reminded him of the cemetery that he had spoken of. There is another case where, on the Rex-Tigard road Huber had contracted to pay them twenty cents a yard, and the work, on account of the use of soft stone or some subsoil drainage conditions, or something that was not contemplated, the contract was a great load on Mr. Huber. He represented to witness that he had not only not made what he hoped to make on the contract, but it brought it down to a very small margin that was not at all satisfactory, and notwithstanding the agreement which he had made to pay Warren Brothers a certain amount on that contract, on the showing that he had made and the grief that he had had on the contract, Warren Brothers felt that it was only fair that they should listen to his point of view and not take all that he was making on the contract, and compromised at an amount that was satisfactory to him. It was several years ago—witness don't

(Testimony of Walter B. Warren.)

remember just exactly when it was—but witness thinks probably they reduced it five or six or seven cents a yard, in meeting Mr. Huber's point of view, which witnes believes was correct. The work has not been satisfactory since, either, and no fault of Mr. Huber's, and no fault of the pavement. It is a condition of subsoil and beyond control of the contractor. Warren Brothers Company have on some occasions, which are very infrequent, met contractors on that ground on a fair showing of their difficulties. [1343—782]

Cross-examination.

(By Mr. LILJEQVIST.)

Mr. Huber paid royalty on the Powell Valley road. Witnes thinks that Mr. Huber paid twenty cents on that contract; fifteen or twenty cents, he is not positive. Witness has no doubt A. J. Hill was speaking on behalf of the Warren Brothers Company when he stated to the state he would hold back ten thousand dollars, or was commissioned to hold back ten thousand dollars, on eighty-five thousand yards. Witness was not there at that time. Witness thinks Mr. Hill told him what he had done. Counsel hands witness certified copy of the minutes from the Oregon Highway Commission from which witness refreshes his memory, and witness stated he has heard about it. He remembers the point coming up. Witness thinks that if Mr. Hill made a statement of that kind that the company would back him up on such a proposition. Without having specific authority on a thing of that kind,

(Testimony of Walter B. Warren.)

which he might have to have legally, they would not question an offer made by Mr. Hill in the interests of the company as he saw it at that time. The incident happened over the contract coming up for an award just after the state had passed a law to assume responsibility for the patents, and in the interim between the awarding of the contract and the passing of this law this contract came to a letting. The state wanted to put that in the category of the other contracts that they were evidently planning to question, or at least investigate—they were planning to look into the matter—and so as to put it in the class of those contracts that were to follow they asked Mr. Hill, as witness remembers, specially if they could set aside something out of this contract price, and Mr. Hill undoubtedly took it up with the contractor, [1344—783] the Warren Construction Company, whom evidently he was representing in that statement, and it was agreed that they could reduce the Warren Construction Company bid by that much money and hold it up contingent upon the settlement of the state upon what royalty they were to pay.

Said certified copy of the minutes from the Oregon Highway Commission was marked for identification as Defendant's Exhibit "A–77."

Asked if he knew anything about the bid of the United Contracting Company for the pavement of the Dallas-Suver section of the Pacific Highway, witness thinks that came up within a few months of the letting counsel just spoke of, where the question of the retaining of a certain amount of money

(Testimony of Walter B. Warren.)

by the state was up, and witness believes a similar proposition was put up to the United Contracting Company and an amount held back pending an agreement entered into that the matter would be held in abeyance until the settlement of the amount that the state should pay. Witness don't think the amount they agreed to hold back had any particular bearing on the amount that they had agreed with Warren Brothers should be the royalty. He didn't have an understanding with the manager of that company; witness thinks the amount was suggested —he don't know who suggested—the amount was suggested possibly on the basis of some sliding scale that had been discussed of what the company might charge for the use of the patent. Witness was not there at the time those bids were opened. Witness doesn't personally know that they had any agreement with the United Contracting Company with [1345—784] reference to the royalty at all. Possibly Mr. Hill at that time, right on the drop of the hat, hearing whether they were going to award a contract or not, may have talked to them and made an arrangement with them, but witness has no doubt that the amount was the amount that they agreed to hold back. Witness don't think it would have any bearing on the amount they would pay Warren Brothers Company. They would naturally try to make the amount as little as possible. Witness remembers the Island City-La-Grande-Hot Lake contract. The contract was awarded Warren Construction Company. Mr. Hill represented the Warren Brothers Company in

(Testimony of Walter B. Warren.)

that matter before the Highway Commission. Witness' company is willing to back up anything that Mr. Hill put up to the Highway Commission. They would with any representative who was acting in good faith, even though it might not be in keeping with their own ideas. Whatever he agreed should be the situation in that particular contract, so far as royalty is concerned, Warren Brothers Company would abide by it. Counsel hands witness certified copy of the minutes of the Highway Commission, May 7, 1919, and witness remembers that proposition being put up to the Highway Commission, after it happened. It was not discussed with him beforehand. Witness thought it was a very fair proposition at that time, though. The state had been laying very large areas of pavement, and they figured the pavement particularly fitted that particular place, and Mr. Hill had in mind the large areas that were being used in the state and offered to make no charge on that particular road,—witness imagines to keep within the estimate, [1346—785] the money they had available. That was five miles of a road.

Said certified copy of the minutes of the Highway Commission, May 7, 1919, was marked for identification as Defendant's Exhibit "A–78."

That was a contract with the Warren Construction Company, and Warren Brothers Company simply waived the amount of the charge against the Warren Construction Company, and they in turn were able to offer that there would be no liability for the use of the patent. Witness don't think War-

(Testimony of Walter B. Warren.)

ren Brothers Company ever charged the Washington Paving Company less than fifteen cents, and he thinks it was generally eighteen, sometimes twenty. They did in some instances charge them fifteen. The Oregon Independent Company, they charged fifteen cents.

Q. Then on work done by the Warren Construction Company you charged royalty all the way from nothing up to how much? Twenty-five cents?

A. No, fifteen cents, what we charged the Warren Construction Company. There were individual cases which came up in a large volume of business that we tried to be reasonable in meeting the situation that might develop, and the exceptions really proved the rule, because the exceptions were very few.

Witness didn't know the laying of bitulithic upon a macadam base or ordinary crushed rock base had been dispensed with by the Highway Commission as a failure in Oregon. It is not a failure. It is a very great success. Witnes knows it is a very great success. He has been over a good many miles —Columbia River Highway, Powell alley, Wild Horse Road up in Umatilla County—it is a success, a very great success. The state, in their judgment, as Warren Brothers see it—they have a perfect right to do so—feel that with the increasing traffic coming on these narrow roads that it is good business for them to lay a bituminous base under the [1347—786] pavement, and in their judgment they are doing that, and it undoubtedly makes a

(Testimony of Walter B. Warren.)

stronger pavement, but it certainly was not because the other pavement was not a success.

Q. Isn't it because the other pavement won't stand up?

A. No, it is not, because under bad sub-soil conditions that exist in Oregon, under certain conditions in Oregon where the road is laid under a side hill and the seepage of water comes down underneath and weakens the sub-base, that two inches of surface without anything underneath but mud is not an engineering question—it is not considered good engineering under those conditions to build a pavement two inches thick, and they have, recognizing on certain roads the poor sub-soil conditions in Oregon, partly based on development through the absence of use of it—are laying a thicker pavement to meet increased traffic, which is coming very fast on these roads, but there are so many cases of long service in excellent condition of the pavement without it that it is really to meet the exceptional cases, and their inability to see them ahead of time, five or ten years before they happened, that they are playing safe and doing what they think in their judgment is the proper thing to do.

Q. They are laying them with a heavy base now, are they not, just because the two-inch wearing surface on the crushed rock base will not stand up?

A. Under weak sub-soil conditions—it is the only reason why it won't stand up—which gives away.

Plaintiff rests. [1348—787]

Testimony of Roy A. Klein, for Defendant.

ROY A. KLEIN was thereupon called as a witness in behalf of the defendant herein, and, having been sworn, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

Mr. Klein is the secretary whose name appears on the two certified copies marked for identification Defendant's Exhibit "A–77" and "A–78." And that is the seal. Those are correct copies of the original minutes. The statements contained there are correct statements of what occurred before the commission.

The papers heretobefore marked for identification Defendant's Exhibit "A–77" and Defendant's Exhibit "A–78" were thereupon received in evidence.

The Highway Commission's experience was that it made a better pavement to lay bitulithic on a macadam base rather than on an open crushed rock base, and for that reason after some of the contracts were started they required the contractors to fill the voidage in the open crushed rock with screenings, making a macadam base of it rather than an open crushed rock base. That was the next step that was taken before the five-inch standard was adopted,—that is, a three-inch bituminous base and a two-inch wearing surface. In fact, their present practice is to lay a macadam base, so to speak, underneath the five-inch pavement. The macadam base varies according to sub-soil condi-

(Testimony of Roy A. Klein.)

tions, but usually not less than six inches deep—six inches of coarser rock intermingled with screenings. Then on top of that they have [1349—788] three inches of bituminous base. Asked how dense that is made, witness stated he is not really familiar with that part of the work. Upon this macadam base they have a three-inch bituminous base; and upon that they place the wearing surface. Asked why the commission found it necessary to adopt that kind of a pavement witness stated they were beginning to have failures over different parts of the state, and as a matter of insurance against traffic that might be expected at some future date, they thought it good practice to bolster up the two-inch top. They felt that it was too thin for the traffic that was coming on the roads.

Mr. LILJEQVIST.—Then what you are laying is really a three-course pavement, I understand?

Mr. MONTAGUE.—I object to the question as irrelevant and immaterial.

The COURT.—I don't think that has any bearing on the question of reasonable royalty, inasmuch as it is only wearing surface.

Mr. LILJEQVIST.—Take an exception.

Testimony of Oskar Huber, for Defendant.

OSKAR HUBER was thereupon called as a witness in behalf of the defendant herein, and having been sworn, testified as follows:

Direct Examination.

(By Mr LILJEQVIST.)

Witness is the defendant in this case. He is

(Testimony of Oskar Huber.)

familiar with what pavements he laid before May 5, 1920, in Oregon; under those three contracts mentioned in this suit, the Salem-Dallas, the Green Springs Mountain-California line, and in the Green Springs Mountain Road to Ashland. [1350—789] Witness paid a royalty of fifteen cents a yard to Warren Brothers Company on these other contracts that he had before these three involved. To his recollection that is the most he has ever paid.

Testimony of Roy A. Klein, for Defendant (Recalled).

ROY A. KLEIN was thereupon recalled as a witness in behalf of the defendant herein, and, having been previously sworn, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

Witness procures some books and states in reference to Defendant's Exhibit "A–78," which was the Island City-La Grande-Hot Lake section, there was 56,300 yards laid there. He don't think that was all laid before May 5, 1920. That was the amount that was in the contract when it was let. He don't know whether that was all laid or not. He don't think so. With reference to Defendant's Exhibit "A–77," the Adams-Athena job, there was 84,500 square yards involved in that contract. Counsel hands witness certified copy of minutes of meeting of April 16, 1919, with the United Contracting Company, and witness stated there was 18,800 square yards involved in that. At the time the

(Testimony of Roy A. Klein.)

contract was let, of course, it was known how many square yards there were in this job, and the royalty, so-called, was figured back from that yardage, to arrive at the amount that is mentioned in here, $2,068.00. The manager of that company is Welton—he don't recall his initials. [1351—790]

Testimony of Kenneth S. Hall, for Defendant (Recalled).

KENNETH S. HALL was thereupon recalled as a witness in behalf of the defendant herein, and having previously been sworn, testified as follows:

Direct Examination.

(By Mr. LILJEQVIST.)

Q. Mr. Hall, will you state what kind of a pavement is being laid of bituminous material for the Highway Commission?

Mr. MONTAGUE.—That goes in under the objection.

The COURT.—Yes.

A. At the present time?

Q. (By Mr. LILJEQVIST.) Yes.

A. It is—what you might call our standard construction is a three-inch bituminous base with a two-inch bituminous concrete top.

In most cases now the Highway Commission are putting the base on a macadam or a well rocked foundation. There have been some cases where it is laid just on the ground. This bituminous base is very similar to the mixture for the top. It is largely rock, and a greater amount of rock and less

(Testimony of Kenneth S. Hall.)

sand. The density of it, as far as voids and mineral aggregates are concerned, usually runs lower than it does on top. It has been found, on account of the heavy traffic that our roads are getting now, that the two-inch top on a crushed rock base was not sufficient to withstand the impact of traffic. [1352—791]

Cross-examination.

(By Mr. LYMAN.)

Q. When you spoke about the two-inch bituminous concrete top you meant the same as the two-inch bitulithic structure?

A. Well, it is the two—asphaltic concrete is what we call it now.

Q. It is the same thing as bitulithic, that you used to call bitulithic?

A. Well, it is possibly the same thing that you call bitulithic, yes.

Q. Did you call it bitulithic in the contracts?

A. It was laid under the—yes, laid under your specifications, where you call it that.

Defendant rests. [1353—792]

In the District Court of the United States for the District of Oregon.

No. E.-8516—IN EQUITY.

WARREN BROTHERS COMPANY,

Complainant,

vs.

OSKAR HUBER,

Defendant.

The defendant and appellant, Oskar Huber, tenders and presents the foregoing as his statement of the evidence in the above-entitled case and prays that the same be approved by the Court and made a part of the record.

The foregoing contains all the testimony, excepting exhibits, in the case in narrative form and where the testimony herein is set forth in the form of question and answer it is so set forth for the reason that the evidence could not otherwise be clearly understood, or is ambiguous or relates to testimony excluded by the Court and upon which the defendant has based an assignment of error.

I. H. VAN WINKLE,
J. M. DEVERS,
L. A. LILJEQVIST,
Solicitors for Defendant and Appellant.

[1354—793]

In the District Court of the United States for the District of Oregon.

E.–8516.

WARREN BROTHERS COMPANY,

Complainant,

vs.

OSKAR HUBER,

Defendant.

Order Approving Statement of Evidence and Directing Original Exhibits to be Sent to the Court of Appeals.

The foregoing statement of the evidence submitted on the trial of the above-entitled cause under the bill of complaint, the answer, notices, and pleadings in relation thereto having been duly lodged on the 28th day of March, 1923, in the office of the clerk of this court by appellant, Oscar Huber, and respondent, Warren Brothers Company, having made its objections and amendments to said statement of evidence, and this matter having been on stipulation of the parties and by order of Court duly continued from time to time until now, and amendments and objections having been satisfactorily adjusted and settled, said statement of evidence on the appeal of Oskar Huber is hereby approved by the Court and ordered placed on file with the clerk of this court.

Dated this 19th day of December, 1923.

R. S. BEAN,
Judge. [1355]

In the District Court of the United States for the District of Oregon.

E.–8516.

WARREN BROTHERS COMPANY,

Complainant,

vs.

OSKAR HUBER,

Defendant.

Stipulation Re Statement of Evidence.

Attorneys for defendant-appellant, Oskar Huber, herein, having prepared and compared the original statement of evidence which is lodged with the clerk of this court and which after the settlement of objections and amendments thereto submitted by the complainant, was approved by the Court and filed with the Clerk of the Court, with the within and foregoing written transcript of said statement of evidence, so approved by the Court,—

NOW, THEREFORE, it is hereby stipulated and agreed by and between the parties to the foregoing cause, by their respective attorneys of record, that the within and foregoing typewritten statement of evidence tendered to the Clerk of the United States District Court for the District of Oregon, for his certificate, is a true transcript of said original statement of evidence approved by the Court and filed in the above-entitled cause, and that the clerk of said court shall certify the said typewritten tran-

script without comparison thereof with the original transcript of evidence, so approved by the Court.

RICHARD W. MONTAGUE,
Of Attorneys for Complainant.
L. A. LILJEQVIST,
Of Attorneys for Defendant-Appellant. [1356]

AND AFTERWARDS, to wit, on Wednesday, the 19th day of December, 1923, the same being the 37th judicial day of regular November term of said Court—Present, the Honorable Charles E. WOLVERTON, United States District Judge, presiding,—the following proceedings were had in said cause, to wit: [1357]

In the District Court of the United States for the District of Oregon.

E.-8516.

WARREN BROTHERS COMPANY,
Complainant,

vs.

OSKAR HUBER,
Defendant.

Minutes of Court—December 19, 1923—Order Directing Forwarding of Original Exhibits.

It appearing to the Court that it is proper and necessary that the original exhibits, including physical specimens of paving and paving materials and other samples, offered in evidence as exhibits in said

case and referred to in the statement of evidence incorporated therein by reference, should be inspected by the United States Circuit Court of Appeals in their original form,—

It is hereby ORDERED that all said exhibits offered and received in evidence in said case, including the specimens of paving and paving materials and other samples, as well as exhibits offered and which were not received in evidence by the Court and were thereby identified as being offered under the statutes providing for the offering of evidence over objection and exception, be transmitted by the Clerk to said Circuit Court of Appeals in original form in connection with the statement of evidence and the transcript, and that Plaintiff's Exhibit 4, being the record in the Owosso case, Plaintiff's Exhibit 5, being the record in the case of Warren Brothers Company vs. New York, Plaintiff's Exhibit 6, being the record in Warren Brothers Company vs. Evans, the Plaintiff's Exhibit 7, being the record in Warren Brothers Company vs. Pace, need not be printed as a part of the record herein.

Dated this 19th day of December, 1923.

R. S. BEAN,
Judge. [1358]

In the District Court of the United States for the District of Oregon.

No. E.–8516.

WARREN BROTHERS COMPANY,

Complainant,

vs.

OSKAR HUBER,

Defendant.

Stipulation Re Transcript of Record.

Attorneys for defendant-appellant Oskar Huber herein having prepared and compared with the original record the within typewritten transcript,—

Now, therefore, it is hereby STIPULATED AND AGREED by and between the parties to the within proceedings that the within typewritten record tendered to the Clerk of the United States District Court for the District of Oregon for his certificate is a true transcript of the record in the within cause, and that the clerk of said court shall certify the said typewritten transcript without comparison thereof with the original record.

RICHARD W. MONTAGUE,
Of Attorneys for Complainant.
I. H. VAN WINKLE,
J. M. DEVERS,
L. A. LILJEQVIST,
Attorneys for Defendant-appellant. [1359]

In the District Court of the United States for the District of Oregon.

No. E.–8516.

WARREN BROTHERS COMPANY,

Complainant,

vs.

OSKAR HUBER,

Defendant.

Certificate of Clerk U. S. District Court to Transcript of Record.

United States of America,
District of Oregon,—ss.

The attorneys for the respective parties to the within proceedings having stipulated that the within typewritten transcript of the record as prepared, compared, and tendered to me for certification by the attorneys for the defendant-appellant is a true transcript of the record in this case, and that I shall certify the same without comparison,—

NOW, THEREFORE, in accordance with the said stipulation, I, G. H. Marsh, Clerk of the District Court of the United States for the District of Oregon, do hereby certify without comparison with the original, that the foregoing transcript of record in the case in which Warren Brothers Company is complainant and Oskar Huber is defendant is a full, true, and correct transcript of the record and proceedings [1360] had in said court in said cause

as the same appear of record and on file at my office and in my custody.

And I further CERTIFY that the fee for certifying to the within transcript, to wit, the sum of Sixty-five cents ($.65), has been paid by the said defendant-appellant.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seal of said Court at Portland, in said district, this 21st day of December, A. D. 1923.

[Seal] G. W. MARSH,
Clerk. [1361]

[Endorsed]: No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Oskar Huber, Appellant, vs. Warren Brothers Company, a Corporation, Appellee. Transcript of Record. Upon Appeal from the United States District Court for the District of Oregon.

Filed December 24, 1923.

F. D. MONCKTON,
Clerk of the United States Circuit Court of Appeals for the Ninth Circuit.

By Paul P. O'Brien,
Deputy Clerk.

In the District Court of the United States for the District of Oregon.

No. E.–8516—IN EQUITY.

WARREN BROTHERS COMPANY,

Complainant,

vs.

OSKAR HUBER,

Defendant.

Order Extending Time Sixty Days to File Record and Docket Cause.

This cause came on this 28th day of March, 1923, to be heard on the petition of Oskar Huber, defendant and appellant in the above-entitled cause, praying for an enlargement of time in which to file the record in this cause in the United States Circuit Court of Appeals for the Ninth Circuit;

And it appearing to the Court that the record contains many exhibits and is a large record and that the statement of evidence submitted for the examination and approval of the Court has been lodged in the office of the clerk of this court and is a large and voluminous record and that two solicitors for the complainant reside at Boston, Massachusetts, and considerable time will probably be required to permit them to examine said statement of evidence submitted for the approval of this court and for the making of such corrections, if any, as may be agreed upon by counsel or may be directed by the Court; and it appearing that said defendant will hardly have time to file the same with the clerk

of the United States Circuit Court of Appeals for the Ninth Circuit by the 27th day of April, A. D. 1923, which is the time required by law;

It is therefore ORDERED, ADJUDGED, and DECREED that the said defendant and appellant be and he is hereby, allowed in addition to the thirty days allowed him by law, sixty days from April 27th, A. D. 1923, in which to file the record in this cause with said clerk of the United States Circuit Court of Appeals for the Ninth Circuit.

Ordered, adjudged and decreed in open court this 28th day of March, A. D. 1923.

CHAS. E. WOLVERTON,
District Judge.

Copy received Mar. 28th, 1923.

RICHARD W. MONTAGUE,
Of Solicitors for Complainant.

[Endorsed]: No. E.–8516—In Equity. In the District Court of the United States for the District of Oregon. Warren Brothers Company, Complainant, vs. Oskar Huber, Defendant. Order Extending Time to File Record in This Cause.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Order Under Subdivision 1 of Rule 16 Enlarging Time to and Including ————, 192—, to file Record and Docket Cause. Filed Apr. 2, 1923. F. D. Monckton, Clerk. Refiled Dec. 24, 1923. F. D. Monckton, Clerk.

In the District Court of the United States for the District of Oregon.

No. E.–8516.

WARREN BROTHERS COMPANY,
Complainant,

vs.

OSKAR HUBER,
Defendant.

Order Extending Time to and Including June 29, 1923, to File Record and Docket Cause.

Now at this time on motion of the attorneys for defendant and appellant,—

IT IS ORDERED, that the defendant and appellant shall have sixty days further time in addition to the time heretofore allowed by the Court within which to file their record and transcript on appeal herein with the clerk of the Circuit Court of Appeals of the United States for the Ninth Circuit.

Dated April 30th, 1923.

R. S. BEAN,
Judge.

[Endorsed]: No. E.–8516. In the District Court of the United States for the District of Oregon. Warren Brothers Company, Complainant, vs. Oskar Huber, Defendant. Order.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Order Under Subdivision 1 of Rule 16 Enlarging Time to and Including June 29, 1923, to File Record and Docket Cause.

Filed May 3, 1923. F. D. Monckton, Clerk. Refiled Dec. 24, 1923. F. D. Monckton, Clerk.

In the District Court of the United States for the District of Oregon.

No. E.–8516.

June 27, 1923.

WARREN BROTHERS COMPANY

vs.

OSKAR HUBER.

Order Extending Time to and Including August 15, 1923, to File Record and Docket Cause.

Now, at this day for good cause shown, IT IS ORDERED that the time for filing the transcript of record on appeal in the above-entitled cause and docketing the same in the United States Circuit Court of Appeals for the Ninth Circuit be, and the same is hereby, extended to and including August 15, 1923.

R. S. BEAN,
Judge.

[Endorsed]: No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Order Under Subdivision 1 of Rule 16, Enlarging Time to and Including August 15, 1923, to File Record and Docket Cause. Filed Jul. 2, 1923. F. D. Monckton, Clerk. Refiled Dec. 24, 1923. F. D. Monckton, Clerk.

In the District Court of the United States for the District of Oregon.

No. E.–8516.

WARREN BROTHERS COMPANY,

Plaintiff,

vs.

OSKAR HUBER,

Defendant.

Order Extending Time to and Including October 1, 1923, to File Record and Docket Cause.

Upon motion of attorneys for defendant for an order extending the time within which to file a transcript in the above-entitled cause, and it being shown to the Court that there is good cause for such extension,—

It is therefore ORDERED that defendant have to and including the 1st day of October, 1923, to file and docket its transcript on appeal in the above-entitled cause.

R. S. BEAN,

Judge.

Dated this 8th day of August, 1923.

[Endorsed]: No. E.–8516. In the District Court of the United States, for the District of Oregon. Warren Bros. Company, Plaintiff, vs. Oskar Huber, Defendant. Order Extending Time. Filed Aug. 18, 1923. F. D. Monckton, Clerk. Refiled Dec. 24, 1923. F. D. Monckton, Clerk.

In the District Court of the United States for the District of Oregon.

E.–8516.

WARREN BROTHERS COMPANY,

Complainant,

vs.

OSKAR HUBER,

Defendant.

Order Extending Time to and Including November 1, 1923, to File Record and Docket Cause.

Upon motion of the solicitors for the defendant for an order extending the time within which to file and docket a transcript on appeal in the above-entitled cause, and it being shown to the Court that there is good cause for such extension, and the complainant having consented by stipulation to such extension,—

It is ORDERED that defendant have to and including the 1st day of November, 1923, within which to file and docket his transcript on appeal with the United States Circuit Court of Appeals for the Ninth Circuit in the above-entitled cause.

Dated this 24th day of September, 1923.

R. S. BEAN,

Judge.

[Endorsed]: No. E.–8516. In the District Court of the United States for the District of Oregon. Warren Brothers Company, Complainant, vs. Oskar Huber, Defendant. Order Extending Time.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Order Under Subdivision 1 of Rule 16, Enlarging Time to and Including November 1, 1923, to File Record and Docket Cause. Filed Sep. 26, 1923. F. D. Monckton, Clerk. Refiled Dec. 24, 1923. F. D. Monckton, Clerk.

In the District Court of the United States for the District of Oregon.

E.–8516.

WARREN BROTHERS COMPANY,

Complainant,

vs.

OSKAR HUBER,

Defendant.

Order Extending Time to and Including December 1, 1923, to File Record and Docket Cause.

Upon motion of the solicitors for the defendant for an order extending the time within which to file and docket a transcript on appeal in the above-entitled cause, and it being shown to the Court that there is good cause for such extension, and the complainant having consented by stipulation to such extension,—

It is ORDERED that defendant have to and including the 1st day of December, 1923, within which to file and docket his transcript on appeal with the United States Circuit Court of Appeals for the Ninth Circuit in the above-entitled cause.

Dated this 31st day of October, 1923.

R. S. BEAN,
Judge.

[Endorsed]: No. E.–8516. In the District Court of the United States for the District of Oregon. Warren Brothers Company, Plaintiff, vs. Oskar Huber, Defendant. Order Extending Time.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Order Under Subdivision 1 of Rule 16 Enlarging Time to and Including December 1, 1923, to File Record and Docket Cause. Filed Nov. 5, 1923. F. D. Monckton, Clerk. Refiled Dec. 24, 1923. F. D. Monckton, Clerk.

In the District Court of the United States for the District of Oregon.

E.–8516.

WARREN BROTHERS COMPANY,
Complainant,

vs.

OSKAR HUBER,
Defendant.

Order Extending Time to and Including January 1, 1924, to File Record and Docket Cause.

Upon motion of the solicitors for the defendant for an order extending the time within which to file and docket a transcript on appeal in the above-entitled cause, and it being shown to the Court that there is good cause for such extension, and the com-

plainant having consented by stipulation to such extension,—

It is ORDERED that defendant have to and including the 1st day of Jan'y, 1924, within which to file and docket his transcript on appeal with the United States Circuit Court of Appeals for the Ninth Circuit in the above-entitled cause.

Dated this 23d day of November, 1923.

R. S. BEAN,
Judge.

[Endorsed]: In the District Court of the United States for the District of Oregon. Warren Brothers Company, Complainant, vs. Oskar Huber, Defendant. Order Extending Time. Filed Nov. 26, 1923. F. D. Monckton, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Order Under Subdivision 1 of Rule 16 Enlarging Time to and Including Jan. 1, 1924, to File Record and Docket Cause. Filed Nov. 26, 1923. F. D. Monckton, Clerk. Refiled Dec. 24, 1923. F. D. Monckton, Clerk.

No. 4171

United States
Circuit Court of Appeals
For the Ninth Circuit.

BOOK OF EXHIBITS.
(IN THREE VOLUMES)

OSKAR HUBER,

Appellant,

vs.

WARREN BROTHERS COMPANY, a Corporation,

Appellee.

VOLUME I.
(Pages 1 to 448, Inclusive.)

Upon Appeal from the United States District Court for the District of Oregon.

Filmer Bros. Co. Print, 330 Jackson St., S. F., Cal.

No. 4171

United States

Circuit Court of Appeals

For the Ninth Circuit.

BOOK OF EXHIBITS.

(IN THREE VOLUMES)

OSKAR HUBER,

Appellant,

vs.

WARREN BROTHERS COMPANY, a Corporation,

Appellee.

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Filmer Bros. Co. Print, 330 Jackson St., S. F., Cal.

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[Clerk's Note: When deemed likely to be of an important nature, errors or doubtful matters appearing in the original certified record are printed literally in italic; and, likewise, cancelled matter appearing in the original certified record is printed and cancelled herein accordingly. When possible, an omission from the text is indicated by printing in italic the two words between which the omission seems to occur.]

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KNOW ALL MEN BY THESE PRESENTS: THAT WHEREAS, I, FREDERICK J. WARREN of Newton in the County of Middlesex and Commonwealth of Massachusetts, whose post office address is Boston in the County of Suffolk and said Commonwealth, am the inventor of a certain improvement in pavements for which I have made application for Letters Patent of the United States, to wit, Serial No. 60,450, filed May 16, 1901, and

WHEREAS Warren Brothers Company, a corporation duly organized under the laws of the State of West Virginia and having a place of business in said Boston, is desirous of acquiring my interest in the same,

NOW THEREFORE, be it known that for and in consideration of one dollar and other good and valuable considerations to me paid by said Warren Brothers Company, the receipt whereof is hereby acknowledged, I, the said Frederick J. Warren, have sold, assigned, transferred, and set over, and by these presents do sell, assign, transfer, and set over unto the said Warren Brothers Company the full and exclusive right to the said invention and to the Letters Patent of the United States which may be granted therefor. And I do hereby authorize and request the Commissioner of Patents to issue the said Letters Patent upon the aforesaid application to the said Warren Brothers Company as the assignees of my entire right, title, and interest in and to the same for the sole use and behoof of

the said Warren Brothers Company and its legal representatives and assigns.

IN TESTIMONY WHEREOF, I have hereunto set my hand and seal this twenty-eighth day of May, 1902.

FREDERICK J. WARREN. (Seal)

Signed in presence of,

RALPH L. WARREN.

H. F. FOWLE.

COMMONWEALTH OF MASSACHUSETTS.

SUFFOLK, ss. BOSTON, May 28, 1902.

Then personally appeared the above-named Frederick J. Warren and acknowledged the foregoing instrument to be his free act and deed.

Before me,

(Seal) HENRY F. FOWLE,
Notary Public.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 3.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

2–390.

UNITED STATES OF AMERICA,
Department of the Interior,
United States Patent Office.

To all to whom these presents shall come, Greeting:

THIS IS TO CERTIFY that the annexed is a true copy from the Records of this Office of the File Wrapper and Contents in the matter of the Letters Patent of

Frederick John Warren,

Number 727,505, Granted May 5, 1903

for Improvement in Pavements.

IN TESTIMONY WHEREOF I have hereunto set my hand and caused the seal of the Patent Office to be affixed at the City of Washington, this 1st day of October, in the year of our Lord one thousand nine hundred and thirteen and of the Independence of the United States of America the one hundred and thirty-eighth.

[Seal] R. T. FRAZER,
Acting Commissioner of Patents.

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NUMBER (SERIES OF 1900).

A

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PATENT No. 727505 1697

Name—Frederick John Warren.

of Newton,

County of

State of Massachusetts.

Invention—Pavements.

Division of App., No. , filed

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Countersigned J. W. Babson	, 190	, 190
	For Commissioner.	For Commissioner.
Notice of Allowance	April 15, 1903	, 190
Final Fee Cash $20	Apl 16, 1903	, 190
" " Cert.	, 190	, 190
Patented	May 5,	, 1903
Associate Attorney	Attorney Clarke & Raymond 35 Court St.	
Address	Address. Boston, Mass.	
Patent No.	Date of Patent	

Case A.

One 5ct. and Two 10ct.
I. R. stamps affixed and canceled
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No. 1224.

APPLICATION FOR LETTERS PATENT.

To the Commissioner of Patents,
Washington, D. C.:

YOUR PETITIONER Frederick John Warren of Newton in the County of Middlesex, and Commonwealth of Massachusetts, whose Post office address is 143 Federal, S T., Boston, Mass. hereby prays that Letters Patent may be granted him for Improvement in Pavements set forth in the annexed Specification, and hereby appoints F. F. RAYMOND, 2d, doing business as Clarke & Raymond
35 Court St.
(Registered No. 1224) at ~~19 Pemberton Square~~ Boston, Mass., his Attorney, with full power of substitution and revocation, to prosecute this Application, to make alterations and amendments therein, to receive the Patent, and to transact all business in the Patent Office connected therewith.

FREDERICK J. WARREN.

Case A

SPECIFICATION.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, Frederick John Warren of Newton in the County of Middlesex and Commonwealth of Massachusets, a citizen of the United States, have invented a new and useful Improvement in PAVEMENTS of which the following is a full, clear and exact description, reference being had to the accompanying drawings, forming a part of this specification in explaining its nature.

The invention relates to an improvement in the class of pavements which comprises a base of mineral matter and a plastic uniting medium consisting of a natural or artificial asphalt or coal tar composition which are intimately associated together and used as the main upper or top surfacing of the road-bed.

The invention is based upon my discovery that to ensure the best conditions of construction, wear and life in such pavements, the portion of the pavement to which my invention relates must be made as dense, as free from voids as possible and also stable and non-liable to displacement, and upon my further discovery that what has ordinarily been supposed to be the best provision for eliminating voids and establishing stability has, as a matter of fact, been almost the poorest provision for accomplishing these purposes. The provision usually accepted as the best is that in which the mineral matter used as a basis of the pavement and united by the plastic asphalt vehicle shall be in the

shape of a sand or fine gravel. This, however, is an error, as I have discovered by experiment that there is a smaller percentage of voids in a pavement which contains mineral components which are of relatively large size. The method has been in the construction of this class of pavements to exclude from its composition all pieces of stone or sand larger than 1/10 of an inch in diameter, but by so doing the smallest percentage of voids that it has been possible to produce has been 21% of the aggregate, while by the use of the larger sized grains or pieces, say up to those which will pass through a two-inch ring, and employing with these larger grains proper quantities of the smaller sizes, down to an impalpable powder, it is possible to reduce the voids of the mineral base below 10% of its bulk, and such a mixture when assembled and compacted together will form a dense, solid, homogeneous, compact body with the smallest percentage of voids and possessing the highest degree of stability and one in which the largest and smallest pieces are associated with each other indiscriminately throughout the structure and one which, because of the sizes of the pieces and their arrangement with respect to each other, offers the smallest areas of surfaces for the attachment of the plastic composition of them, so that not only is a superior binding effect or union obtained by the plastic composition, but a smaller quantity of it is necessary for the purpose of obtaining the superior result or product.

I prefer to use from 1 to 3% of impalpable powder, from 10 to 30% of material between impalpable powder and ¼-inch in size and from 50 to 80% of material larger than ¼-inch in size. I have found that these ingredients when associated together produce a mass or body having less than 20% of voids.

I prefer to use as the uniting or plastic composition one which comprises asphalt and an oil flux heated to a moderate heat to provide the requisite fluidity, but I do not confine myself to any special form of artificial or natural asphalt.

It will be understood that the mineral components are not arranged in the form of layers of the same size, but are mingled with each other from the upper to the lower surface of the pavement, and that the plastic composition permeates the entire mass, uniting the various sized particles thereof, filling the voids and forming the surfaces. It will be understood that this pavement is used as the upper or wearing section of a road-bed and that it may be covered if desired with a relatively thin surfacing of clear asphalt cement or an asphalt or bituminous composition of any desired nature. In some instances there may be rolled into this thin surfacing, while it is yet soft, sufficient sand, gravel or fine stone to prevent its displacement by traffic.

I will now describe the invention in connection with the drawings where

Figure 1 is a view in horizontal section of enough of a pavement to illustrate in a conventional way

the features of my invention, while Figs. 2 and 3 are corresponding views representing the addition of a surfacing to the structure of Fig. 1.

In the drawings:—

A represents the portion of the road-bed to which my invention relates and which may be called the wearing section of the road-bed and is the portion which covers and is supported by the McAdam or other foundation B. In the wearing section are

b. 12-02

represented some of the larger ~~metal~~ mineral Λ pieces, some pieces of intermediate size and some of the smaller pieces and also the plastic composition which unites them together and C represents the surfacing to which I have referred. It is represented as somewhat thicker in Fig. 3 than in Fig. 2. It will be understood, however, that the drawings are simply illustrative and that it is not possible to represent the variations in the sizes of the ~~metal~~ mineral Λ pieces, atoms and powder which are employed in producing my improved result.

In laying the wearing surface, the pieces, particles and atoms of the base are intimately associated with the plastic asphalt composition which is then spread uniformly upon the prepared foundation and which in setting becomes very dense, solid, stable and freer from voids than any pavement of which I have knowledge.

This density of the structure, stability, its relative freedom from voids very much improves the wearing properties of the pavement, its resistance

to the action of water and on account of its dense structure prevents the volatilization or oxidation of the essential oils in the cementing medium, increases its life and, while producing these improvements it also enables the wearing surface to be produced at a smaller cost because a smaller quantity of plastic asphalt material is required than where the percentage of voids is larger.

A pavement or wearing section of a pavement having the features of this invention possesses various advantages, among which are the following: First, the percentage of mineral employed is increased and the percentage of plastic uniting medium decreased as compared with analogous pavements as now laid. Second, the wearing properties of the pavement are increased and improved and this is due to the employment of a larger proportion of mineral to the proportion of the uniting medium and also to the fact that the mineral base is of such a structure, owing to the employment of a considerable percentage of relatively large pieces; larger than are now used; that a very rigid and stable effect is obtained and one which reduces strain and wear upon the uniting medium, more of the wear being borne by the mineral base and less by the uniting medium than is common. Third, the interstices of voids formed by such mineral components are also of a different character in that they are larger, fewer and therefore the asphalt or bituminous uniting medium contained in them forms a cellular structure which is stronger and adheres

better to the surfaces of the mineral components than where the voids or interstices are more numerous and of less size. I am also enabled because of the size of these interstices or voids to use an asphalt or bituminous uniting medium of a softer nature and at a lower temperature than could otherwise be used.

Sub. C March 26-03

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States:—

1. A wearing section of a pavement comprising a base of pieces of mineral varied as to size from a powder to pieces larger than one quarter of an inch in diameter and having the proportions to each other herein indicated to decrease the percentage of voids, with a plastic, bituminous composition combined with and united to said mineral base.

Sub. A Feb. 12-1902

2. A wearing section of a pavement having a mineral base of fine, intermediate and coarse pieces in about the proportions indicated herein, and mingled together to decrease the percentage of voids, a plastic, bituminous composition intimately associated with said mineral pieces uniting them together and filling the said voids, and a thin, finishing coating of relatively clear or non-mineralized, bituminous medium applied to the upper surface of the said wearing section and united to it.

3. A wearing section of a pavement consisting of fine, intermediate and coarse pieces of mineral of the sizes and proportions described and adapted when mingled together to provide a solid, stable base not liable to displacement by traffic and a low per-

centage of voids, and a plastic, bituminous binder or uniting medium combined with said base, filling the voids and uniting its individual parts.

4. A pavement comprising a suitable foundation, a wearing section mounted on said foundation comprising a mineral base of fine, intermediate and coarse pieces assembled together in the proportions indicated and for the purpose of ensuring stability combined with elimination of voids, and an asphalt, plastic combining medium intimately associated with said mineral pieces to fill the voids thereof, and a thin finishing body applied to the top of the wearing section comprising a relatively clear bituminous plastic medium and sand gravel or fine stone rolled into the same to prevent its displacement.

FREDERICK JOHN WARREN.

Witnesses
F. F. RAYMOND 2d.
J. M. DOLAN.

State of Massachusetts,
County of Suffolk.

Frederick John Warren, the above-named Petitioner, being duly sworn, deposes and says that he is a citizen of the U. S. and resident of Boston, Mass. and that he verily believes himself to be the original, first, and sole inventor of the improvement in Pavements described and claimed in the annexed specifications; that he does not know and does not believe that the same was ever known or used before his invention or discovery thereof; or patented or described in any printed publication in any country

before his invention or discovery thereof, or more than two years prior to this application; or in public use or on sale in the United States for more than two years prior to this application, and that no application for patent on said improvement has been filed by him or his representatives or assigns in any foreign country, except as follows:

FREDERICK JOHN WARREN.

Sworn to and subscribed before me this 9th day of May, 1901.

[Seal] F. F. RAYMOND 2d,
Notary Public.

Mail Room, May 16, 1901. U. S. Patent Office.
Serial No. 60450, Paper No.
Application.
Filed May 16, 1901.
F. J. Warren.

2—260.

Div. Room No. 207
Address only
"The Commissioner of Patents,
Washington, D. C."

Paper No. ———
All communications respecting this application should give the serial number, date of filing, and title of invention.

M. A. M.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE.
WASHINGON, D. C.,
June 20, 1901.
MAILED " " "
DIVISION 15.

Frederick J. Warren,
Care of Clarke & Raymond,
No. 35 Court Street, Boston, Mass.
(Case A.)

Please find below a communication from the

your

EXAMINER in charge of ~~the~~ application ~~of~~ Serial No. 60,450, filed May 16, 1901, for Pavements.

F. I. ALLEN.

~~E. B. MOORE.~~

Commissioner of Patents.

This application has been examined.

Although perhaps the term "metal" is sometimes used in the trade, yet it is suggested that mineral be substituted in lines 7 and 14, page 4.

Claim 3, after "and" line 5, insert having.

The alternative form of claim 4 is objected to and would be remedied by cancelling "gravel or fine stone."

So far as set out in the claims, applicant's pavement shows no patentable novelty. Many references might be cited to show the use of a mixture of stones of various sizes with bituminous compositions. It will be enough to cite for this the patent to Richardson, No. 607,884, July 26, 1898, Paving, Concrete.

Claims 1 and 3, therefore, are rejected upon the above patent or upon the patent to Murdock, 394,126, Dec. 4, 1888, Paving Concrete.

Claims 2 and 4 are rejected upon these references in view of the patent to Jones, No. 169,005, Oct. 19, 1875, Paving, Concrete.

CAMPBELL,

Ex.

F.L.E.

Serial No. 60450, Paper No. 1.

Dated June 20, 1901.

F. J. WARREN.

Serial No. 60450 Paper No. 2
Amend't. .A
Filed Feb. 12, 1902.

UNITED STATES PATENT OFFICE.

Examiner's Room 207.

Frederick J. Warren. PAVEMENTS.
Filed May 16, 1901. Ser. No. 60,450.

35 Court St., Boston, Mass.
February 5, 1902.

Commissioner of Patents,
Washington, D. C.

Sir:

We have Office Letter of June 20th in this case and in reply would say that from the nature of the references cited we are of the opinion that we have not made clear the nature of the applicant's present invention.

He had no intention of claiming the subject matter of any of the references. His invention consists in a new tpye of bituminous pavement, one in which the mineral element, if it may be so termed, plays a much more important and valuable part than it has ever before played in any bituminous street pavement. It in fact dispossesses the functions of the prior uses of bitumen in that it forms the principal part of the pavement and is intended to receive the wear to which the pavement is subjected, relegating the bitumen to the secondary position of filling up the voids which cannot be filled with mineral particles. To accomplish this the inventor makes such a selection of mineral particles from particles of the very finest nature to pieces of substantial size often

two inches in diameter and associates these pieces uniformly together according to a definite schedule of proportions, he having ascertained that the lowest percentage of voids is obtained in this way and for the purpose of securing a mineral foundation which is stable in and of itself and one that shall have the lowest or substantially the lowest extent of voids, therefore requiring the smallest amount of bitumen for filling them.

The application is amended as follows:—

SPECIFICATION.

Page 4, lines 7 and 14 change "metal" to | mineral. |

The claims are erased and the following substituted:

A 1. A wearing layer of street sheet pavement having a body of mineral ingredients varied as to size from a powder to pieces larger than ¼ of an inch in diameter bearing the proportions to each other herein indicated, uniformly mingled together and requiring approximately the smallest percentage of bituminous composition to fill the voids therein which would otherwise exist when laid, and said bituminous composition applied to the ingredients before they are laid and serving in the layer to fill the voids, combine and unite together the ingredients, and whereby a wearing layer is obtained which was approximately the largest percentage of mineral ingredients combined with approximately the smallest percentage of bituminous composition, all as and for the purposes set forth.

Sub. B Feb. 24–1903

2. A wearing layer of a street sheet pavement having as a base a body of mineral ingredients varied as to size bearing such proportions to each other and so uniformly mingled together as to provide a foundation the stability of which is inherent and in which the percentage of voids is reduced to near a minimum, and a bituminous composition for combined with filling said voids, ~~applied to~~ Λ the mineral ingredients before they are laid and ~~and~~ applied with them layer to a proper foundation whereby a wearing ~~section~~ Λ is obtained which has approximately the largest percentage of mineral ingredients which can be used, combined with approximately the smallest percentage of bituminous composition all as and for the purpose set forth.

3. A wearing layer of a street sheet pavement having as a base a body of mineral ingredients, varied as to size, bearing such proportions to each other and so uniformly mingled as to provide a structure the stability of which is inherent, and in which the percentage of voids is reduced to near a minimum and a bituminous composition filling said voids, combining with and uniting together the ingredients whereby a wearing layer is obtained which has approximately the largest percentage of mineral which can be used combined with approximately the smallest percentage of bituminous composition, and a thin finishing coating of relatively clear non-mineralized bituminous medium applied and united layer to the upper surface of said wearing Λ ~~section,~~ as and for the purpose set forth.

4. A street pavement comprising a suitable sub-foundation and a wearing water-proofing ~~metal~~ layer mounted on and attached to said foundation, comprising a body of mineral ingredients varied as to size, bearing such proportions to each other and so uniformly mingled throughout the mass as to provide a structure the stability of which is inherent, and in which the percentage of voids is reduced to near a minimum, and a bituminous composition for filling said voids, applied to the mineral ingredients before they are laid and combined with them upon the sub-foundation, whereby a wearing layer is obtained which has approximately the largest percentage of mineral which can be used ~~with~~ and approximately the smallest percentage of bituminous composition, the whole forming a waterproof covering to the sub-foundation, as and for the purposes set forth.

Very respectfully,
CLARKE & RAYMOND,
Attorneys for Fred J. Warren.

U. S. Patent Office. Filed Feb. 12, 1902. Division XV.

2—260

Div. Room No. 207
Address only
"The Commissioner of Patents,
Washington, D. C."

Serial No. 60, 450 Paper No. 3
Paper No. Rej.
All communications respecting this application should give the serial number, date of filing, and title of invention.

M. A. M.

DEPARTMENT OF THE INTERIOR
UNITED STATES PATENT OFFICE
WASHINGTON, D. C.,

February 25, 1902.
MAILED " " "

DIVISION 15.

Frederick J. Warren,
c/o Clarke & Raymond,
35 Court Street, Boston, Mass.

Please find below a communication from the EX-
your
AMINER in charge of ~~the~~ application ~~of~~ Serial No. 60,450, filed May 16, 1901, for Pavements.

F. I. ALLEN.
~~E. B. MOORE,~~
Commissioner of Patents.

Case considered as amended on the 10th instant.

The claims are rejected on Warren, No. 675,430, June 4, 1901, that patent discloses mineral ingredients varied as to size from a powder to pieces larger than one quarter of an inch in diameter, &c.

CAMPBELL,
Examiner.

Serial No. 60450 Paper No. 4

U.S.PATENT OFFICE
FILED
FEB 24 1903
Division XV.

Amend't. B
Filed Feb. 24, 1903.

UNITED STATES PATENT OFFICE.
Examiner's Room No. 207.
Frederick J. Warren.
Filed May 16, 1901.

PAVEMENTS.
Serial No. 60,450.

---

35 Court St., Boston, Mass.
February 18, 1903

Commissioner of Patents,
Washington, D. C.

Sir:—

In reply to the last Office Letter in this case we would say that the applicant allowed the Warren patent cited in this case to go to issue only after the present case was filed and with a complete knowledge of its contents, and no reason is now seen for re-issuing it to cover the matter of this application for the following reasons:—

The patent No. 675,430 is drawn to a complete pavement or roadway structure from the surface to the foundation. The Examiner is respectfully referred to the statement of invention therein as to the correctness of this assertion. The present case is not drawn to an entire pavement or structure but merely to a surfacing layer or mixture. This mixture could be applied to many other foundations than that disclosed in patent No. 675,430, or indeed without any special foundation. On the other

hand many surfacing mixtures or layers could be applied to the foundation claimed in No. 675,430. It was for these reasons that the applicant doubted the propriety and feasibility of claiming any specific surfacing *per se* in No. 675,430.

The Examiner's attention is directed to the claims of the Warren patent cited. He will note that claim 1 is drawn to a rather specific statement of a surfacing layer as applied to a prepared foundation and as watertight to protect said foundation. This claim evidently includes the foundation; it may be in a rather inferential manner but none the less clearly. The construction that the courts place upon such claims is now well settled. As regards claim 2, the Examiner will note that it is clearly drawn to the entire structure. Except for the last three lines of claim 1, such claim might be considered a sub-combination of the matter presented in claim 2.

Then as to both statement of invention and claims, No. 675,430 is drawn to a complete pavement structure.

Furthermore the Warren patent cited could not possibly be a reference, because even the surfacing described in that patent is different in some respects from that claimed in the present application. The Examiner will note the correctness of this statement upon consideration of the various grades of ingredients and proportions or percentages stated in the two cases. In the present case for instance much more material passes at a ½″ mesh and is caught upon a ¼″ mesh than in the patent.

The Examiner is well aware that when two applications to different species are concurrently pending in the Office, the applicant may elect in which case to present his broad claims; and the issue of a patent on the application, not presenting the broad claims, cannot affect the applicant's right to include such claims in the case remaining in the Office.

In view of the above, it is thought that the Warren patent No. 675,430 will be withdrawn as a reference in this case.

The only other patent cited which it is thought worth discussing is the Richardson patent. This patent would seem to have no bearing on the claims now in the case.

The Examiner will note that the mineral mixture of Richardson resembles the applicant's in one way only, that is, in having particles of various sizes and grades. Applicant is not seeking to claim any such broad idea. Applicant states distinctly that the bulk of his grades are within certain limits and he sets the limits. Of his material 50–80% will not pass through a ¼" mesh while only 3% is an impalpable powder. Tichardson on the other hand states (in line 86, P. 1) that but a small proportion of his material is of large size. In the first paragraph ending on the top of page 2, Richardson in speaking of his various grades emphasizes this statement in a more specific matter. In the second paragraph, same page, he says that "not more than 15% of the material used should be so large as to fail to pass a forty mesh, prefer-

ably less, and but a small amount, or none, should fail to pass the ten and twenty mesh sieves." In the third paragraph, same page, not 7% passes the forty mesh and only ½ % the ten mesh.

The great bulk of applicant's material on the other hand lies above the ¼" mesh.

It is therefore apparent that Richardson represents a grade of material differing far more radically from applicants than he differs from the prior art. Richardson's finely granulated material lacks the inherent stability of applicant's material. A heavy weight passing through it would leave a furrow. Where this stability is lacking a comparatively hard and rigid binder is necessary to maintain the material in place. Such a binder is naturally subjected to an amount of wearing comparable with that to which the mineral itself is subjected, and to properly perform its functions the binder can contain but little of the permanent softening oils. The great advantages of such oils for lending life and elasticity to pavements are too well known to be discussed. Owing to their softening qualities it has however, been heretofore impossible to use them to anything like the extent that would be otherwise desirable. The rigidity of applicant's mineral structure permits of the free use of such oils.

Another feature of applicant's invention as heretofore stated resides in the minimum amount of voids present. As a result of these new proportions, a large area of mineral is presented for wear, and a minimum of binder is required.

In the claims herewith submitted it has been attempted to set forth the structure in a clear and definite manner, and in many instances the precise limits as to proportions and degrees have been stated.

CLAIMS.

Cancel the claims and substitute:—

Cancelled March 4–1903

B 1. A street pavement mixture composed of mineral ingredients ranging in grades from 3″ in diameter to an impalpable powder, the grades being so proportioned as to give the mineral structure sufficient sustaining power to permit the use of a bituminous binder of a quality softer than could otherwise be employed, and taking Trinidad asphalt as a basis of comparison, softer than 70° penetration by Bowen's penetrating machine, in combination with such a binder.

March 4–1903

1 ~~2~~. A street pavement mixture composed of mineral ingredients ranging in grades from 3″ down to an impalpable powder, from 50 to 80 per cent. of such mineral ingredients lying between ¼″ and 3″ in diameter, in combination with a bituminous binder.

"

2 ~~3~~. A street pavement mixture composed of mineral ingredients of several grades from an impalpable powder to 3″ in diameter, over 50% of

" such ingredients being larger than ¼″ in diameter, and a bituminous binder ~~containing sufficient per-~~

" ~~manent oil to render it softer than could otherwise~~

" ~~be employed, and taking Trinidad asphalt as a~~

" ~~comparison, softer than 70° penetration by Bowen's~~

" ~~penetrating machine.~~

" 3 ~~4~~. A street pavement mixture composed of mineral or wearing ingredients, of which approximately 50 to 80% are between ¼″ to 3″ in diameter, approximately 10 to 49% between an impalpable powder and ¼″ in diameter, and approximately 1 to 3% of an impalpable powder, in combination with a binder.

" 4 ~~5~~. A street pavement mixture composed of mineral or wearing ingredients, of which approximately 50 to 80% lies between ¼″ and 3″ in diameter, approximately 10 to 49% between an impalpable powder and ¼″ in diameter, and approximately 1 to 3% an impalpable powder, in combination with a bituminous binder, of which the soft, oily constituent is sufficiently great to render the binder itself too flexible to maintain the structure rigid.

March 4–03 " 5 ~~6~~. In a street pavement, a bituminous-mineral structure, the mineral ingredients of which mixed and
are Λ of several grades, so graded to give the structure an inherent stability.

" 6 ~~7~~. A bituminous street pavement structure
" mixed
" containing Λ mineral ingredients ~~irregularly~~ ~~placed~~
" ~~with~~ ~~regard~~ ~~to~~ ~~each~~ ~~other~~ ~~and~~ of such grades as to give the structure an inherent stability.

" 7 ~~8~~. A bituminous street pavement mixture comprising a binder in combination with a mineral structure of inherent stability composed of wearing material of several grades uniformly mixed.

" 8 ~~9~~. A street paving mixture comprising a

bituminous binder in combination with a mineral structure of inherent stability.

Cancelled Mar. 26–03

9 ~~10~~. A street paving mixture of a comparatively soft and flexible binder in combination with a mineral structure of inherent stability composed a mixture of
of Λ irregular material.

" Mar. 26 –03

9 ~~10~~ ~~11~~. A street pavement wearing section composed of a mineral structure of inherent stability formed of several grades of material so proportioned as to have a per cent. of voids less than 21% of the whole, in combination with a comparatively soft bituminous binder filling said voids and rendering the whole permanent in nature and elastic and waterproof in character.

" Mar. 26 –03 " "

~~11~~ 10 ~~12~~. A mixture for street paving purposes bituminous a mixture of composed of a Λ binder and Λ mineral ingredients of several grades having less than 21% of voids, the binder being sufficient in quantity to fill the voids.

" A pavement structure composed

12 ~~13~~. Λ ~~A mixture for street paving purposes~~ of mineral or wearing ingredients and a binder softer than Trinidad asphalt of a quality softer than fixed by 70° penetration by Bowen's penetrating machine.

" Cancelled Mar. 26 –03

A pavement structure composed

13 ~~14~~. Λ ~~A street paving. mixture composed~~ of mineral or wearing ingredients and a bituminous binder softer than Trinidad asphalt of a quality softer than fixed by 70° penetration by Bowen's penetrating machine.

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14 ~~15~~. A street paving mixture composed of mineral or wearing ingredients of grades ranging from about 3″ in diameter to an impalpable powder, and a bituminous binder containing sufficient ~~permanent~~ oils to render it as soft as for comparison Trinidad asphalt, softer than 70° penetration by Bowen's penetrating machine.

16. A street paving mixture wherein the relation as to space to be occupied by the binding material is less than 21% of the whole.

structure composed of a

11 ~~15~~ ~~17~~. A street paving ∧ mixture ~~composed~~ of mineral or wearing ingredients, and a plastic binder, ~~the mineral or wearing ingredients having a~~ between the mineral ingredients being ∧ the space, ∧ less than 21% of the whole, and the plastic binder occupying said space.

Very respfy.,
CLARKE & RAYMOND,
Attys. for Fred J. Warren.

U. S. PATENT OFFICE
FILED
MAR. 14, 1903.
Division XV.
Serial No. 60450 Paper No. 5. Amend't. Filed March 4, 1903.

Amendment.

Frederick J. Warren,
Pavements;
Filed May 16, 1901. Before Examiner,
60450.

Hon. Commissioner of Patents,

Sir: In the above-entitled case please amend as follows:

In view of conference today had with the Examiner and without waiving any right to present the subject-matter hereby withdrawn in another application.

Cancel claim 1.

after

Claim 3, beginning ~~with~~ "binder" line 4, cancel to end of claim.

Claim 6, line 2, insert after "are" the words "mixed and"

Claim 7, line 1, after "containing" insert "mixed" Line 2, cancel "irregularly placed with regard to each other and"

Claim 10, line 3, insert after "of" the words "a mixture of"

Claim 12, line 2, insert after "and" the words "a mixture of"

Claims 13 and 14, cancel lines 1 to "of" and substitute "A pavement structure composed"

Claim 15, line 4, cancel "permanent"

Cancel claim 16.

Claim 17, line 1, insert after "paving" the words "structure composed of a". Line 1, cancel "composed". Lines 2 and 3 cancel the phrase "the mineral or wearing ingredients having". Line 3, insert after "space" the phrase "between the mineral ingredients being". Line 3, substitute "the" for "a" before "space."

Respectfully submitted,
FREDERICK J. WARREN,
CLARKE & RAYMOND,
His Attorneys.

2—260.

Div. Room No. 207
Address only
"The Commissioner of Patents,
Washington, D. C."

Paper No. 6
All communications respecting this application should give the serial number, date of filing, and title of invention.

M. A. M.

DEPARTMENT OF THE INTERIOR.
UNITED STATES PATENT OFFICE.
WASHINGTON, D. C.,
March 5, 1903.
Mailed " " "
Division 15.

Frederick J. Warren,
c/o Clarke & Raymond,
35 Court Street, Boston, Mass.

Please find below a communication from the EX-

your

AMINER in charge of ~~the~~ application ~~of~~ Ser. No. 60,-450, filed May 16, 1901, for Pavements.

F. I. ALLEN.

~~E. B. MOORE,~~

Commissioner of Patents.

Case considered in view of the amendments of the 24th ult., and the 4th inst.

Claims 5–11, inclusive are rejected upon British patent to Ward, 13,168 of 1900, 106 Bit. & Res., (Paving).

The reference to "Bowen's penetrating machine" in the claims is not properly supported by the specification. In their present form claims 12 and 13 are considered met in Barber, 330,197, Nov. 10, 1885, 106–31. Before final action on these two claims, however, applicant should carefully explain how the softness of his binder is determined.

CAMPBELL,

Examiner.

F. L. E.

U. S. PATENT OFFICE, MAIL ROOM,
FILED MAR 26 1903
MAR 27 1903 U. S. PATENT OFFICE.
Division.

Serial No. 60,450, Paper No. 7.
Amend't C.
Filed March 26, 1903.

UNITED STATES PATENT OFFICE.
Examiner's Room No. 207.
F. J. Warren. PAVEMENTS.
Filed May 16, 1901. Ser. No. 60,450.

35 Court St., Boston, Mass.
March 19, 1903.

Commissioner of Patents,
Washington, D. C.

Sir:—

We have Office Letter of March 5, 1903, in this case and in reply thereto we make the following amendments:—

SPECIFICATION.

Page 5, cancel the sentence beginning in line 25 and ending in line 29 and substitute therefor the following:—

C Because of the inherent stability obtained by me by the careful selection and proportioning the several grades of mineral ingredients, I am enabled to use an asphalt or bituminous uniting medium of a softer nature and at a lower temperature than could otherwise be used. This is because in my case the wear and strain falls upon the mineral ingredients and not upon the binder, which latter may

be as soft as desirable. In this application, however, I do not claim, broadly, a binder or cement of this character. I have reserved the same to be claimed in my co-pending application No. 60,819.

Claims.

Cancel claim 9.

Add the following claims:—

C1 ~~13~~ 12. A mixture of mineral or wearing ingredients of several grades, the ingredients of the descending grades in size and quantity being so proportioned to each other and to the voids existing in the larger grades as to fill the voids and impart to the structure an inherent stability, in combination with a bituminous cement or binder.

~~14~~ 13. A mixture to be used as a pavement having an inherent stability composed of mineral or wearing ingredients of several grades, the grades being thoroughly mixed and thereby uniformly distributed throughout the mass and being of sizes and quantities so proportioned that ingredients of the same grade are uniformly in contact with each other, and a bituminous cement or binder.

Cancel claims 12 and 13 and 14.

The subject matter of these claims is presented in applicants copending application 60819.

Claim 11, line 2, insert "bituminous" before "binder."

Very respectfully,

FRED. J. WARREN.

By CLARKE & RAYMOND,

Attys.

Serial No. 60450, Paper No. 8,
Letter and Affidavits.
Filed March 30, 1903.

Frederick J. Warren.
Pavements
Filed May 16, '01
#60450

U. S. PATENT OFFICE,
FILED
MAR. 30, 1903
DIVISION XV

Washington, March 30, 1903.

Commissioner of Patents,

The affidavits herewith filed in the above-entitled case carry the date of applicant's invention back of the British patent to Ward of record, and put the case in condition for allowance.

It is respectfully requested that the case be passed to issue.

Very respectfully,
CLARKE & RAYMOND,
For Applicant.

U. S. PATENT OFFICE,
FILED
MAR. 30, 1903
Division XV.

AFFIDAVIT OF FREDERICK J. WARREN IN RE APPLICATION FOR LETTERS PATENT OF THE UNITED STATES OF PAVEMENTS.

Frederick J. Warren.
Filed May 16, 1901. Ser. No. 60,450

I, Frederick J. Warren of Boston, Massachusetts, being duly sworn, depose and say that I am the above-named applicant; that for many years I have been engaged in the business of road and pavement

making, that I had conceived the subject matter of the invention contained and referred to in the above-named application and had reduced the same to a practical working basis and fully completed it before the month of July of the year 1900, and before that date I had fully and often explained the embodiment thereof to others, among them being my brother, Mr. George C. Warren, who also is an expert in the art of pavement building and therefore was fully able to understand and appreciate my description of my said invention and its value; that said description of my invention to my said brother consisted of a statement by me that I had discovered a means for imparting to bituminous pavements an inherent stability which they had heretofore lacked and that to effect this result it was necessary to employ minerals of several grades, to proportion the sizes of the smaller minerals with a regard to the size of voids between the larger minerals, and to employ sufficient quantities of such smaller ingredients to about substantially fill said voids between the larger minerals, and to supply bituminous cement in proper quantities; and I further do depose and say that I have no knowledge and do not believe that the said invention has been in public use or on sale in this country, or patented or described in any printed publication in this or any foreign country for more than two years prior to the date of my application for said Letters Patent, and that I have never abandoned the said invention.

FREDERICK J. WARREN.

New York
State of ~~Massachusetts,~~
New York
County of ~~Suffolk,~~ —ss.

Personally appeared Frederick J. Warren and acknowledged the above instrument to be his free act and deed, before me, this 25th day of March, 1903.

[Seal] F. G. CUTTER,
Notary Public.

U. S. PATENT OFFICE,
FILED
MAR. 30, 1903.
Division XV.

AFFIDAVIT OF GEORGE C. WARREN IN RE APPLICATION FOR LETTERS PATENT OF THE UNITED STATES OF PAVEMENTS.

Frederick J. Warren.
Filed May 16, 1901. Ser. No. 60,450.

I, George C. Warren of Boston, Massachusetts, being duly sworn, depose and say that I have been engaged for many years in the art of road and pavement building and am fully conversant with all the matters pertaining thereto; that prior to July, 1900, my brother Mr. Frederick J. Warren, who is the above named applicant for Letters Patent, confided and fully described to me many times the subject matter of an alleged invention of his relating to the selection of mineral ingredients for bituminous pavements or roadways; that the disclosure was verbal and consisted of a statement by the said

Frederick J. Warren that by carefully selecting mineral ingredients of certain grades and proportioning the amount of material of each grade a bituminous structure could be obtained which had great inherent stability; that in said disclosure he stated that the size of the smaller minerals was to be proportioned to the voids of the larger minerals, and that said smaller minerals were to be present in quantities to substantially fill said voids. Finally that the minerals were to be thoroughly mixed with and united by a bituminous binder; and that the practical significance and value of his said invention was fully understood and appreciated by me at that time; that I then considered the invention as complete in every particular, and it has not been changed or modified since that date; that I have read and am thoroughly conversant with the subject matter of the above entitled application for Letters Patent, and consider the pavement structure therein rejected on certain British Letters Patent to one Ward to be the structure disclosed to me by said Frederick J. Warren, as above set forth.

GEORGE C. WARREN.

New York
State of ~~Massachusetts,~~
New York
County of ~~Suffolk,~~—ss.

Personally appeared George C. Warren and acknowledged the above instrument to be his free act and deed, before me, this twenty-sixth day of March, 1903.

[Seal] F. G. CUTTER,
Notary Public.

2–181. Serial No. 60450

Division.
Communications should be addressed to
"The Commissioner of Patents,
Washington, D. C."

DEPARTMENT OF THE INTERIOR,
U. S. PATENT OFFICE,
Washington, D. C., April 15, 1903.

Frederick John Warren
c/o Clarke & Raymond
35 Court St., Boston, Mass.

Sir:—Your application for a patent for an improvement in pavement, filed May 16, 1901, has been examined and allowed.

The final fee, twenty dollars, must be paid, and the letters patent bear date as of a day not later than six months from the time of this present notice of allowance.

If the final fee is not paid within that period the patent will be withheld, and your only relief will be by a renewal of the application, with additional fees, under the provisions of Section 4897, Revised Statutes. The office aims to deliver patents upon the day of their date, and on which their term begins to run; but to do this properly applicants will be expected to pay their final fees at least twenty days prior to the conclusion of the six months allowed them by law. The printing, photolithographing, and engrossing of the several patent parts, preparatory to final signing and sealing, will consume the intervening time, and such work will not be done until after payment of the necessary fees.

When you send the final fee you will also send, distinctly and plainly written, the name of the inventor and title of invention as above given, date of allowance (which is the date of this circular), date of filing, and, if assigned, the names of the assignees.

If you desire to have the patent issue to assignees, an assignment containing a request to that effect, together with the fee for recording the same, must be filed in this office on or before the date of payment of final fee.

After issue of the patent uncertified copies of the drawings and specifications may be purchased at the price of 5 cents each. The money should accompany the order. Postage stamps will not be received.

Respectfully,

F. I. ALLEN,

Commissioner of Patents.

☞After allowance, and prior to payment of the final fee, applicants should carefully scrutinize the description to see that their statements and language are correct, as mistakes not incurred through the fault of the office, and not affording legal grounds for reissues, will not be corrected after the delivery of the letters patent to the patentee or his agent.

[Stamped across face:]

☞In remitting the final fee give the serial number at the head of this notice.

☞If payment is made by check or draft, the credit allowed is subject to the collection of the same.

2—327.

$20 Received
Apr 16, 1903 H
Chief Clerk, U. S. Patent Office.

MEMORANDUM
of
FEE PAID AT UNITED STATES PATENT OFFICE.

(Be careful to give correct Serial No.)
Serial No. 60450 .....190 .
Inventor: Frederick J. Warren.
Patent to be issued to: Frederick J. Warren.
Name of invention, as allowed: Pavements.
Date of payment: April 16, 1903.
Fee: $20.00.
Date of filing: May 16, 1901.
Date of circular of allowance: April 15, 1903.

The Commissioner of Patents will please apply the accompanying fee as indicated above.

CLARKE & RAYMOND,
Attorney.

Send patent to
Clarke & Raymond,
35 Court St.,
Boston, Mass.

94. PAVING,

Concrete.

1901

CONTENTS:

Application 1	papers. O. K.
1. Rej	June 20, 1901
2. Amend't A	Feb. 12–1902
3. Rej	Feb. 25. '02
4. Amend't–B	Feb. 24–1903
5. Amendt–	March 4–1903
6. Rej	Mar. 5, 1903
7. Amend't. C	March 26–1903
8. Letter & Affidavits	March 30–1903

TITLE:

Improvement in Pavement.

Plaintiff's Exhibit No. 8.

In the Supreme Court of Alberta, Judicial District of Calgary.

S. C. No. 3107.

BITULITHIC AND CONTRACTING LIMITED AND WARREN BROTHERS COMPANY,
Plaintiffs,

and

CANADIAN MINERAL RUBBER COMPANY, LTD. AND THE CITY OF CALGARY,
Defendants.

JUDGMENT.

Of the Honorable Mr. Justice Hyndman

The Plaintiffs seek an injunction and damages against the defendants for an alleged infringement of certain of their rights as licensees and patentees respectively, namely: Claims 4–5–6–9 and 11 of a certain *"new and useful improvement in street pavements"* letters patent for which were duly granted pursuant to the "Patent Act" of the Dominion of Canada, on the 5th day of July, 1904, Numbered 88,116, in favor of Frederick John Warren and his assigns, giving him the exclusive right, privilege and liberty within Canada of making, constructing, manufacturing and vending the said improvements, which patent is still in force. By assignment all the right, title, estate and interest in and to the said Letters Patent was granted to the Plaintiffs, Warren Brothers Company and the Plaintiffs, Bitulithic and Contracting, Limited, are the sole licensees within Alberta of their co-plaintiffs.

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Warren Brothers Company also possess the same patent rights throughout the United States of America and have done a very large business either by themselves or through licensees both in Canada and the United States, and the case is a most important one for the Plaintiffs as well as for the City of Calgary and other communities in Alberta affecting, as it does, their right to construct such pavement municipally or through other contractors, for, in

addition to the question whether plaintiffs' patent has been in fact infringed upon, the defendants also challenge the validity of the patent itself. The case is therefore entitled to very careful consideration.
* * * *

The defendants, the Canadian Mineral Rubber Company, undertook to and did construct the alleged infringing pavement under a contract with the City of Calgary, the circumstances in connection with which are briefly about as follows:

In March, 1912, the defendant City advertised for tenders for pavement to be constructed that year. Several tenders were presented, amongst them being those of the Bitulithic and Contracting, Limited, and the defendant Company. One Doctor Elliott, as agent for defendant Company, appeared before a meeting of the City Council and openly offered to construct pavement identical with a pavement which the plaintiffs, Bitulithic and Contracting, Limited, had laid down in Calgary in 1910 and 1911 and which plaintiffs allege was their patented pavement. Mr. McPhail, the manager of the Bitulithic and Contracting, Limited, was also present and pointed out to the Council in the presence and hearing of Dr. Elliott that their pavement was patented, and that if defendants proceeded to construct such a one his company would take legal proceedings to enjoin them from so doing. Dr. Elliott contended that such patent was not valid and said that he would undertake to fight any claim the Bitulithic and Contracting Company might set up; that he

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knew it was a patented pavement, but such patent "was not worth the paper it was written on." Mr. Child, the then City Engineer, was also present and drew the attention of the Council to the same point. It was eventually decided that a contract be let to the defendant Company to construct one hundred thousand yards of pavement under specifications identical with those of Bitulithic and Contracting, Limited, in 1910 and 1911 and at the suggestion of Mr. Child a clause was inserted in the formal contract dated the 9th of April, 1910, Exhibit 7, which reads as follows:

"26. By reason of the fact that the contractor "agrees by the specifications attached to and form- "ing part of this contract to lay down pavement "similar to Warren's bitulithic pavement recently "laid down in the City by the Bitulithic and Con- "tracting, Limited, it is distinctly agreed and un- "derstood by and between the contractor and the "corporation that if any legal proceedings are insti- "tuted against the contractor or corporation or both "for an infringement of any patent, and as a con- "sequence thereof the work comprised under this "contract is stopped, discontinued or interfered "with by order of a court or judge for a period of "twenty days, whether consecutive or not, the cor- "poration shall have the right to cancel this con- "tract at any time thereafter by giving written no- "tice to that effect in a prepaid registered letter "addressed to the contractor at Calgary, Alberta, "and thereupon all further rights of the contractor

"under this contract shall cease and determine and "the corporation shall have the right to take posses- "sion of the work and complete the same in the "manner provided in Section 16 hereof, and the "contractor agrees to indemnify the corporation "against all claims, damages, suits or actions "brought against the corporation for infringement "of any patent by the contractor and any sums for "which the corporation may be liable shall, if not "paid forthwith by the contractor, be a charge on

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"the bond accompanying this contract. In the "event of the commencement of any actions or pro- "ceedings against the corporation whether the con- "tractor is a party or not, the corporation hereby "gives and grants to the contractor the carriage and "conduct of the same in the name and on behalf of "the corporation and at the contractor's sole cost "and expense."

Construction was begun and the plaintiffs applied to my brother Stuart for an injunction restraining further work, but instead of enjoining defendants it was ordered that moneys which would fall due from time to time from the City under the contract be paid into Court leaving Plaintiff's remedy in damages alone. The defendant Company continued the work which was not completed until some time in 1914.

Assuming for the time being that the Plaintiffs' patent is valid I will consider first whether or not the defendants in fact infringed their rights. Plaintiff put in evidence subject to objection, Ex-

hibits 10 and 11, being reports from J. W. Howard, an engineer of New York, to defendant, citing with reference to the composition of the pavements as laid in Calgary by both Bitulithic and Contracting, Limited, and the defendant company tending to prove the similarity of both pavements, and that they were constructed according to the patent.

Mr. Howard was not an employee of the City, but merely acted as consulting engineer and was paid for services rendered in specific cases only. My opinion under the circumstances is that these reports are not properly admissible, and I uphold Mr. Biggar's objection.

But to my mind even without this evidence there is ample testimony which establishes infringement.

According to witnesses Child, the Ex-Engineer, and Field, the Chemist of the defendant City, the pavement of the defendant Company was doubtless constructed according to the plan or method described in Plaintiff's patent. Field says he checked the weights and saw the batches of mineral aggregate from time to time and that the specifications

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were observed carefully and Craig says the same thing as to following the specifications. I am of opinion that the ingredients employed correspond to the approximate quantities of the materials as described in the patent. The evidence is quite satisfactory that the result was similar to plaintiffs' pavement laid the previous year. The specifications used were similar to those of the plaintiffs in laying the "Bitulithic." Therefore if the specifi-

cations are the same as were used in manufacturing plaintiffs' protected pavement and comprise the method or scheme of the patent, there is no doubt in my mind that the defendants are guilty of infringement.

In considering the question of validity, it is necessary to look at the whole of the specifications and claims which I set out fully at the conclusion of the judgment.

The United States Patent which is identical with the one in question, has been the subject of litigation in several States of the Union, and Plaintiffs, Warren Brothers Company, have in each case been successful in establishing validity of their Patent. The Canadian Patent Law has, to a large extent, been moulded after the United States Laws rather than the English and decisions in our Courts have followed the American rather than the English in many respects.

In England it appears the Plaintiffs must establish, at least, a *prima facie* case of novelty, sufficiency and utility. In the United States the patent carries with it a presumption to this effect and the Canadian decisions appear to have followed in this respect and I so hold in this action.

Copeland v. *Lyman,* 90 O. R. 908. Fisher and Smart on Patents, 215 to 225 and the cases cited there.

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The onus, therefore, is upon the defendants to prove want of novelty, sufficiency of specifications and utility. I held at the trial that it was incum-

bent on the plaintiffs to prove manufacture as required by the Statute which they did to my satisfaction.

The only remaining points to be decided then are as to (1) Novelty, (2) Sufficiency and (3) Utility.

The Invention relates to an "improvement in street pavements" (not a process) which comprises a base of mineral matter and a plastic uniting medium consisting of a natural or artificial asphalt or coal tar composition which are intimately associated together and used as the upper or top surfacing of the road bed. Validity must be decided according to the state of knowledge at the date of the patent (*Vidal* v. *Levinstein,* 29 Rep. Pat. Cas. 259). It is therefore necessary to ascertain what anticipation there has been by any of the known practical methods of construction of pavements considering it not as of the present day, but during the period immediately prior to that of the Plaintiffs' patent. On the evidence I cannot find that there had been any pavements similar in construction to that of the Plaintiffs'. It is quite true that density and stability had been for many years considered most desirable and in fact were sought to be accomplished in various countries, but there does not appear to have been any fixed or known working scheme which would insure it with any degree of certainty. The old methods included granite, stones and wood blocks, brick, as also macadam, tar asphalt and sheet asphalt. The form which most approaches "Bitulithic" appears to have been sheet asphalt. The old familiar macadam was made of

irregular sizes of fairly large broken stone and laid usually in three uniform layers. These layers were crushed down with heavy rollers and on the top small stones, stone dust, or street sweepings were rolled into this which formed a temporary cement. The mixture contained a large percentage of voids

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and would absorb dust, moisture, deposits of horses, etc. The structure changed continually according to the amount of traffic. It became very dusty in dry weather and muddy and slippery after rain and was also unsanitary. Tar macadam was the ordinary macadam structure with a coating of tar. Tar concrete had never been used for street pavements but only for sidewalks. Tar macadam and macadam are often the foundation for the plaintiffs' pavement. Sheet asphalt is composed merely of sand, the interstices being filled with asphalt cement. It is subject to the disadvantage of being too hard and brittle in winter and liable to fracture under traffic as well as being very slippery in wet weather, especially so on slopes. The voids, too, in sand run from 30 to 38%, requiring therefore a very large percentage of expensive cement to fill the spaces. It appears without doubt that the great object in view was the production of a waterproof pavement with the least number of voids; inherent stability and resistance to wear as well as being dustless, noiseless and sanitary and free from liability to fracture.

It appears from the evidence that Warren, the Inventor—who was a paving contractor—made the

business his life work and carried on many experiments. The result of his experiences was that he regarded all pavements up to this time as wrong, owing to the arrangement of the mineral matter and claimed that he discovered by experiment that the usual method, namely, a mixture of sand or fine gravel united by the plastic asphalt vehicle contained a larger percentage of voids than in a mixture of a relatively larger size. His invention was the discovery that an aggregate of large and small pieces of stone graded down to an impalpable powder mixed together in certain proportions would produce a mixture having less than 21% of voids and when so assembled and compacted together would form a dense solid homogeneous body with the smallest percentage of voids and possessing the

highest degree of stability and one in which the largest and smallest pieces are associated with each other indiscriminately throughout the structure and one which because of the sizes of the pieces and their arrangement with respect to each other offers the smallest areas of surfaces for the attachment of the plastic composition to them so that not only is a superior binding effect or union obtained but a smaller quantity of the plastic composition is necessary for the purpose of obtaining the superior result or product. A good deal of evidence was given on the subject of stability. It is not claimed by the inventor that his mineral aggregate has absolute or perfect stability but merely a high degree or greater than any other known pavement. An-

other point of value is the fact that as a result of this arrangement small particles of stone, sand or impalpable powder being used to fill the voids and being much cheaper than asphalt a large saving in cost is the effect in this way. * * *

It seems to me from the evidence that, although it might be admitted that other pavements, *e. g.* macadam may possibly possess as great a density and great stability still the process is altogether different and full of uncertainty. There is no way of ascertaining the density until after it was laid and treated and rolled on the street. The Bitulithic as to all these features is prepared and may be known in advance and is laid down with at least an approximate certainty of its density. The inventor reduced the composition of the mineral aggregate to a certainty which before was uncertain and usually mixed in a haphazard way "hit or miss" as Engineer Craig put it, and this both as to quality and quantity of the mineral ingredients.

Defendants put in as Exhibit 12, copy of United States Patent Number 104325 dated 14th June, 1870, granted to Gabriel Leverick and A. H. Emery as evidence of anticipation of plaintiffs' patent. A careful perusal, however, leads me to the opinion

that although the principle or idea very much resembles that of the patent in question, yet it is plainly distinguishable inasmuch as stress is laid more on the treatment or quality of the tar itself rather than the composition of the mineral aggregate.

(See especially paragraphs 6 and 7 of Exhibit 12.)

I have come to the conclusion therefore that the Plaintiffs' pavement was, at the date of the Letters Patent, not anticipated by any other known at that time and that its novelty has not been successfully challenged.

As to the sufficiency of the specifications the law seems to be well settled that in return for the monopoly or privilege which is granted him in respect to his inventions, the patentee must say clearly and plainly what his invention is so that others practicing the art may learn and use it with facility at the expiration of the term of the Patent—"Uberrima Fides" is required in this respect.

It does not necessarily mean that any person whomsoever may be able to apply and understand them, but that any workman acquainted with the art to which the invention belongs might make, construct and put the invention into practice. In the case at bar it would, I think, mean any person whose business was constructing pavements or analogous works. It would not, I think, include a common laborer doing a part of the rough work of construction, but rather a practical contractor, foreman or overseer.

He must not claim too much, that is, more than his specifications comprise, otherwise his patent will be invalid.

Sufficiency being presumed, I do not see that the defendants have been successful in pointing out and proving wherein the specifications are defec-

tive. The evidence seems to be much to the contrary. The very fact that the defendant company was able to successfully construct the pavement under their contract without apparently any difficulty tends to prove this very point. * * *

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It was argued that the use of certain machinery was absolutely necessary to success in producing the result and the Inventor should have named and described carefully the various machines to be used, not only for testing, but also for the process of mixing the mineral ingredients. As these things change from time to time, I hardly think it incumbent on the patentee to go into details in this regard. The main features are the materials and the proportions thereof employed. Some of the machines for grading and separating the stone and powder are themselves patented inventions and would thus be available to any one in the trade in the usual way. Moreover the witness, George C. Warren, testified that the pavement has been produced without the use of the machines. Testing the material appears to be a most important feature in order to arrive at a satisfactory conclusion as to the exact proportions which ought to be used, but any one skilled in the work ought to be able to do this without the necessity of having the specifications encumbered with details of the testing instruments and operations. Doubtless different operators would use different methods and methods will continue to change from time to time. The evidence of Mr. McPhail was to the effect that some

of the cities in which they performed work they did not own or operate crushing machines but purchased the material from other concerns, the plaintiffs merely having to mix the various grades in the proper proportions.

As to utility I need say little. There is ample evidence that it is a very useful invention and according to City Engineer Craig, and other witnesses, the Bitulithic Pavement is a highly satisfactory one. I hold also that the invention is proper subject matter for a patent.

I therefore find that the patent is valid and has been infringed—and the plaintiffs entitled to an injunction. There will be a reference to the Clerk

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of the Court to ascertain what damages the plaintiffs have sustained by reason of such infringement, any party being at liberty to apply from time to time for further directions. * * *

Dated March 16th, 1915.

J. D. HYNDMAN,
J. S. C.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 10.

EXTRACTS FROM PLAINTIFF'S EXHIBIT No. 10—CONTRACT BETWEEN OSKAR HUBER AND STATE HIGHWAY COMMISSION OF OREGON FOR PAVING ON THE PACIFIC HIGHWAY IN JACKSON COUNTY, OREGON, FROM ASHLAND TO GREEN SPRINGS MOUNTAIN ROAD.

This contract was executed May 6, 1919, by the State Highway Commission, party of the first part, and Oskar Huber, party of the second part, and provides for the paving by said Huber of the "Ashland to Green Springs Mountain Road section of the Pacific Highway" with "Standard Bitulithic Pavement" (p. 83).

This contract contains the same provisions as are contained in the contract Plaintiff's Exhibit 9 quoted above, to which reference is hereby made.

Plaintiff's Exhibit No. 11.

EXTRACTS FROM PLAINTIFF'S EXHIBIT No. 11—CONTRACT BETWEEN OSKAR HUBER AND STATE HIGHWAY COMMISSION OF OREGON FOR PAVING SALEM–DALLAS HIGHWAY IN POLK COUNTY, OREGON.

This contract was executed July 8, 1919, by the State Highway Commission, party of the first part, and Oskar Huber, party of the second part, and provides for the paving by said Huber of the Sa-

lem-Dallas Highway in Polk County, Oregon, with "Standard Bitulithic Pavement."

This contract contains the same provisions as are contained in the contract Plaintiff's Exhibit 9 quoted above, to which reference is hereby made.

Plaintiff's Exhibits 10 and 11 offered and received in evidence were contracts for the Ashland-Green Springs Mountain Road section and the Salem-Dallas Highway, respectively, and their provisions are identical *mutatis mutandis* with those of Exhibit 9 except that the specifications for the Salem-Dallas Highway provided for the use of crushed gravel instead of crushed rock, and in the bid which was accepted was a statement as to the number of square yards to be laid with standard bitulithic pavement, Type F, with a statement opposite said item, which statement was as follows: "Based on using broken stone and gravel in the mineral aggregate and asphalt to be furnished by commission."

Plaintiff's Exhibit No. 12.

FORM 299-1-13-2,000

State Oregon

City [illegible]

(1)

Street [illegible] 19[illegible]

Date														
Lab. No.														
B. C.— D														
L														
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24														
55														
B														
Surface Bit. Plant Hydr.														
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1														
Dust														
B. C.—														
Bitumen %	6.4	6.1	5.9	5.9	6.3	7.0	7.2	6.2	6.6	6.3	6.1	6.6	6.1	6.1	6.6
~~On 1½"~~ %	7.0	~~2.0~~	5.5	11.7	37.6	39.3	33.3	25.2	40.6	30.2	33.1	21.9	37.8	21.9	43.1
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1" %															
¾" %															
½" %	21	24	13	24.7	20.7	23.7	27.0	26.5	19.3	22.3	20.5	25.4	19.5	25.2	14.2
⅜" %	13.0	11.5	9.4	10.9	15.7	14.2	12.7	14.9	13.2	13.8	12.1	11.9	12.6	12.2	6.5
8 %															
10 %	10.0	10.5	11.9	10.3	11.9	13.4	13.9	15.0	14.0	15.6	13.9	16.0	14.5	12.4	14.4
20 %															
30 %															
40 %	5.2	3.9	4.3	5.4	4.8	6.4	5.1	6.9	4.0	5.6	5.6	6.7	4.9	4.6	5.6
50 %															
80 %	1.6	1.0	1.2	1.3	1.3	2.3	1.4	2.6	1.2	1.9	1.4	1.4	1.4	1.4	2.0
100 %	4.9	3.0	3.1	3.0	3.6	5.0	3.1	4.8	3.0	4.0	3.0	4.2	3.2	3.2	3.2
200 %	4.7	2.8	4.0	2.5	4.5	4.9	3.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.0	4.4	4.7
Hrs. Mixed 10	18.2	22.5	24.1	22.7	26.0	22.9	27.0	[illegible]	[illegible]	[illegible]	[illegible]	33.9	27.5	26.0	33.9
Batches "															
Car tracks															
% grade															

No. 1.1

UNITED STATES CIRCUIT COURT OF APPEALS
FOR THE NINTH CIRCUIT
FILED
JAN 2 - 1924
F. D. MONCKTON.
CLERK.

U.S. DISTRICT COURT
DISTRICT OF OREGON
FILED
JUN 8 1922
CLERK

Pltf. Ex. 46

Form 280 4-2-13 1m

V

State Oregon
City Jackson County

Street

19 17

Date	9/13	9/15	9/16	9/17	9/18	9/19	9/20	9/22	9/23	9/24	9/27	9/29	9/30	10/2	10/3	10/4
Lab. No.	01761	01776	01789	01790	01811	01911	01841	01879	01879	01911	01961	01990	02004	02024	02035	02092
B. C. = D	✓	✓	✓	✓				✓	✓			✓				
L					✓								✓			
21 flux																
24																
55																
B																
Surface Bit.																
Plant Hydr.																
Lab. "																
" °Dow																
" °Cg																
F. C. Bit.																
Pen. Hydr.																
" °Dow																
" °Cg																
Bin 6																
5																
4																
3																
2																
1																
Dust																
B. C. =																
Bitumen %	6.1	6.0	6.3	6.1	6.7	6.6	6.9	6.1	6.2	6.1	6.0	5.0	5.9	7.0	6.8	6.1
~~On 1½"~~ %	33.4	36.9	41.2	39.2	33.8	37.9	39.6	[illegible]	36.9	39.6	43.6	49.9	53.3	50.1	38.6	40.4
Pass. 1½" %																
1" %																
½" %																
½" %	17.2	22.5	20.6	19.5	22.5	19.1	13.1	16.2	17.0	16.3	16.0	18.5	13.6	12.9	13.6	16.6
¼" %	13.5	17.1	10.1	10.3	12.2	12.2	10.3	11.6	13.6	11.1	11.9	7.1	10.9	10.5	13.1	13.9
8 %																
10 %	17.0	13.5	12.4	12.6	14.3	16.4	15.2	11.9	17.1	11.7	13.8	11.1	9.6	13.1	15.1	13.9
20 %																
30 %																
40 %	5.2	5.6	4.7	5.5	6.2	6.2	5.7	5.6	5.3	4.7	5.6	3.9	4.7	5.4	7.3	5.8
50 %																
80 %	2.9	1.7	1.4	2.6	1.5	2.2	1.5	2.6	1.2	0.7	1.5	1.2	1.6	1.6	2.3	1.0
100 %	4.2	3.6	3.6	4.5	4.2	3.6	4.3	3.3	3.3	3.0	3.0	2.2	2.2	2.9	4.1	4.0
200 %	4.3	4.1	5.3	5.5	4.7	2.4	6.0	3.5	5.8	2.2	4.6	3.5	4.1	3.5	6.0	4.4
Hrs. Mixed	33.6	28.5	27.4	30.1	31 ✓	30.8	33.0	35.9	27.7	22.3	28.5	21.9	22 ✓	26.5	26.8	29.1
Batches "																
Car Tracks																
% grade																

139

Form 290 6-2-18 1m

State Oregon

City Jackson County

Street

1919

Date	10/6	10/7	10/8	10/9	10/10	10/11	10/13	10/14	10/15	10/16	10/17	10/20	10/21	10/23	10/24	10/25
Lab. No.																
B. C. = D																
L																
21 flux																
24																
55																
B																
Surface Bit. Plant Hydr.																
Lab. "																
" °Dow																
" °Cg																
F. C. Bit. Pen. Hydr.																
" °Dow																
" °Cg																
Bin 6																
5																
4																
3																
2																
1																
Dust																
B. C. =																
Bitumen %	6.0	6.1	7.0	6.0	6.1	6.1	6.0	6.1	6.1	6.1	6.2	6.0	6.3	6.2	6.6	6.0
~~On 1½"~~ %	48.5	51.6	32.7	38.6	51.8	52.5	40.1	52.3	38.9	46.9	42.6	42.8	49.0	47.7	49.0	48.9
Pass. 1½" %																
1" %																
¾" %																
½" %	9.5	16.7	14.2	16.0	13.5	14.0	12.9	9.6	25.2	13.9	12.3	15.2	10.5	12.9	10.8	12.2
⅜" %		9.3	17.9	6.7	10.2	7.0	12.0	10.8	10.	9.8	12.2	12.3	10.9	11.3	9.5	10.6
8 %																
10 %	14.9	11.1	16.3	15.3	11.3	11.8	17.8	13.7	10.9	13.4	15.2	14.1	16.5	15.1	15.8	14.1
20 %																
30 %																
40 %	6.3	3.6	9.1	6.0	5.3	3.9	7.1	5.4	3.8	6.6	7.2	5.7	5.9	5.1	6.4	5.9
50 %																
80 %	1.5	0.9	2.0	1.4	1.4	1.4	1.7	1.6	0.9	2.0	1.9	2.0	1.6	1.2	1.4	1.2
100 %	3.5	2.9	4.3	3.1	3.2	3.0	3.9	3.1	2.5	3.6	4.4	3.8	3.2	2.9	3.2	3.0
200 %	4.0	3.9	4.8	3.9	3.9	4.0	4.5	3.6	3.8	4.8	4.3	4.1	3.4	3.9	3.8	3.9
Hrs. Mixed 10	20.5	22.4	26.5	29.7	26.1	26.1	25.0	29.4	21.7	30.4	32.9	29.7	29.6	28.1	30.6	28.1
Batches "																
Car Tracks																
% grade																

40

Form 299-1-13-2,000

W.O.H.

State Oregon
City Jackson Co.

Street 19

Date	10/2	10/31	11/1	11/2	11/5	11/6			
Lab. No.	07689	07691	07692	07812	07810	07811			
B. C.— D			×						
L	✓				✓				
21 flux									
24									
55									
B									
Surface Bit. Plant Hydr.									
Lab. "									
" °Dow									
" °Cg									
F. C. Bit. Pen. Hydr.									
" °Dow									
" °Cg									
Bin 6									
5									
4									
3									
2									
1									
Dust									
B. C.—									
Bitumen %	6.1	6.0	6.1	6.2	6.1	6.2		6.3	6-7.5
~~On 1½"~~ %	47.2	52.3	48.1	43.6	50.8	43.0		42.1	36-50
Pass. 1½" %									
1" %									
¾" %									
½" %	12.1	13.1	15.5	18.2	14.1	19.5		17.5	12-20
¼" %	10.9	10.2	9.0	14.2	9.2	11.0		12.0	8-12
8 %									
10 %	14.4	12.7	13.7	11.8	11.7	12.9		13.7	-
20 %									
30 %									
40 %	6.0	4.7	5.4	4.3	5.3	4.9		5.6	ok
50 %									
80 %	1.6	1.2	1.3	1.6	1.6	1.7		1.6	ok
100 %	4.0	2.4	3.5	2.9	3.3	3.6		3.5	+
200 %	3.8	3.4	3.3	3.6	4.0	3.1		4.1	ok
Hrs. Mixed	29.8	24.1	27.1	21.0	25.9	26.[illegible]		28.2	
Batches "									
Car tracks									
% grade									

59.6
56.3
3.3
1.0
56.2

141

LOCATIONS:

Lab. No.__________

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

__________ St. ____ side; ____ ft. ____ of ____ curb of __________ St.

79.3 84.2 37 96 85.8

32.5
842
46) 1960
160

858
372
40) 2192 55
200
192

LOCATIONS:

Lab. No.

St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.
St. side; ft. of curb of St.

Plaintiff's Exhibit No. 17.

Portland, Oregon, May 12, 1922.

LABORATORY REPORT No. P. L. 051.

Tests made on sample of Bitulithic pavement laid by Oskar Huber in 1919 in Jackson County, Oregon, on Green Springs Mountain Road to California line section of Pacific Highway. Sample cut by A. E. Schutte, L. Price, and G. A. Jenkins on May 9, 1922, from the east side of the above road at a point one (1) mile (by speedometer reading) north of the Oregon-California line. Sample brought to laboratory by A. E. Schutte and G. A. Jenkins, May 11, 1922, and there analyzed by them on May 11 and May 12, 1922.

ANALYSIS.

Bitumen		6.9%	
Passing	1¼″	12.8%	
"	1″	16.1	
"	¾″	15.6	
"	½″	21.2	65.7%
"	4	8.9	
"	8	2.1	
"	10	5.6	
"	20	3.7	
"	30	1.7	
"	40	1.9	
"	50	2.4	
"	80	1.0	
"	100	3.1	30.4
"	200	4.4	4.4
		100.5	100.5

Percentage of Voids found in Mineral Aggregate, 16.8%.

WARREN BROTHERS COMPANY,
PORTLAND LABORATORY.
By G. A. JENKINS,
A. E. SCHUTTE.

Lab. No. PL 051
Filter 15
Mixture 1130
Total 1145
After Extr 1067
Net 78 6.9%

	Pass 1½		
	Pass 1½	12.8	
	Pass 1½	12.8	
657 on ¼	" 1	16.1	
343 P ¼	" ¾	15.6	
	" 2	21.2	657
	" 4	8.9	
	" 8	2.1	

Sp. grav.

Wt. of Pyc. full water	1615
Agg	500
Total	2115
Wt. Pyc, agg. & bal. water	1932
Displacement	183

$$\text{Sp. gr.} = \frac{500}{183} = 2.732$$

Void test

Sp. gr. matt. used (material of original sample) 2.732

" 10	5.6		Wt. of cone	1204 grams
" 20	3.7		Capacity	1000 cc
" 30	1.7		Contents solid material	
" 40	1.9		2.732 × 1000 =	2732 grams
" 50	2.4		Wt. of cone + min. agg.	3476 "
" 80	1.0		" " min. agg.	2272 "
" 100	3.1	30.4	Voids 2732 — 2272	460
" 200	4.4	4.4	460	
			% Voids ——	16.8
	100.5		2732	

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

Plaintiff's Exhibit No. 18.

Portland, Oregon, May 12, 1922.

LABORATORY REPORT No. P. L. 052.

Tests made on sample of Bitulithic pavement laid by Oskar Huber in 1919 in Jackson County, Oregon, on Green Springs Mountain Road to California line section of Pacific Highway. Sample cut by A. E. Schutte, L. Price, and G. A. Jenkins on May 9, 1922, from the east side of the above road at a point 3.6 miles (by speedometer reading) north of the Oregon-California line. Sample brought to laboratory by A. E. Schutte and G. A. Jenkins, May 11, 1922, and there analyzed by them on May 11 and May 12, 1922.

ANALYSIS.

Bitumen	6.7%	
Passing 1½"	1.9%	
" 1¼"	16.2	
" 1"	10.8	
" ¾"	13.6	
" ½"	21.4	63.9%
" 4	8.7	
" 8	1.9	
" 10	5.1	
" 20	3.5	
" 30	1.9	
" 40	2.1	
" 50	2.8	
" 80	1.4	
" 100	4.1	31.5
" 200	4.6	4.6
	100.0	100.0

Percentage of Voids found in Mineral Aggregate, 15.9%.

WARREN BROTHERS COMPANY,
PORTLAND LABORATORY,
By G. A. JENKINS,
A. E. SCHUTTE.

Lab. No. PL 052

Filter	15				
Mixture	1130				
Total	1145				
After Extr.	1069				
Net	76			6.7%	
		Pass.	1½	1.9	
On ¼	639	Pass.	1¼	16.2	
P ¼	361	"	1	10.8	
	315 4.6	"	¾	13.6	
	274 4.1	"	2	21.4	63.9
	260 1.4	"	4	8.7	

Sp. gr.

Wt. of Pyc.	1615
& agg.	500
Total	2115
Wt. pyc. & agg. full water	1930
	185

185)500(2.70

Void test

Sp. gr. material used (material of original sample)	2.70

232	2.8	"	8	1.9		Wt. of cone	1204 grams
211	2.1	"	10	5.1		Capacity	1000 cc
192	1.9	"	20	3.5		Conts. sold matl. = 2.70 × 1000	2700 grams
157	3.5	"	30	1.9			
106	5.1	"	40	2.1		Wt. cone & min, agg.	3474 "
87	1.9	"	50	2.8		" min. agg.	2270 "
0		"	80	1.4		Voids (2700—2270)	430
		"	100	4.1	31.5	% Voids $\frac{430}{2700}$	15.9
		"	200	4.6	4.6		
				100.0	100.0		

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 19.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Portland, Oregon, April 10, 1922.

LABORATORY REPORT No. P. H. 183.

Tests made to determine percentage of voids in mineral aggregate of P. A. 02810, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on November 5, 1919, and laid at Station 135 plus 00 on Green Springs Mountain Road-California line section of Pacific Highway.

Analysis of P. A. 02810.

Bitumen	6.1%	
Pass. 1¼"	12.7%	
1	16.0	
¾	22.1	
½	14.1	64.9%
¼	6.8	
⅛	2.4	9.2
10	5.9	5.9
20	3.4	
30	2.4	
40	1.9	7.7
50	3.4	3.4
80	1.6	

100	3.3	4.9
200	4.0	4.0
	100.0	100.0

Percentage of voids in Mineral Aggregate, 18.01.

Portland, Oregon, April 10, 1922.

LABORATORY REPORT No. P. H. 182.

Tests made to determine percentage of voids in mineral aggregate of P. A. 02649, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on October 28, 1919, and laid on Green Springs Mountain Road—California line section of Pacific Highway. (Exact location not given. Engineer's stakes missing.)

Analysis of P. A. 02649.

Bitumen	6.1%	
Pass. 1¼″	18.0%	
1	16.0	
¾	13.2	
½	12.1	59.3%
¼	7.5	
⅛	3.4	10.9
10	7.2	7.2
20	4.3	
30	2.9	
40	1.9	9.1
50	4.1	4.1
80	1.6	
100	4.0	5.6
200	3.8	3.8
	100.0	100.0

Percentage of Voids in Mineral Aggregate, 15.93.

Portland, Oregon, April 10, 1922.

LABORATORY REPORT No. P. H. 181.

Tests made to determine percentage of voids in mineral aggregate of P. A. 02501, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on October 21, 1919, and laid at Station 170 plus 80 on Green Springs Mountain Road—California line section of Pacific Highway.

Analysis of P. A. 02501.

Bitumen	6.3%	
Pass. 1½″	1.5%	
1¼	10.0	
1	22.9	
¾	14.6	
½	10.5	59.5%
¼	7.5	
⅛	3.4	10.9
10	8.0	8.0
20	5.2	
30	3.3	
40	2.0	10.5
50	3.9	3.9
80	1.6	
100	3.2	4.8
200	2.4	2.4
	100.0	100.0

Percentage of voids in Mineral Aggregate, 15.87.

Portland, Oregon, April 10, 1922.

LABORATORY REPORT No. P. H. 180.

Tests made to determine percentage of voids in mineral aggregate of P. A. 02374, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on October 15, 1919, and laid at Station 1 plus 80 on Green Springs Mountain Road—California line section of Pacific Highway.

Analysis of P. A. 02374.

Bitumen	6.1%	
Pass. 1¼″	4.3%	
1	12.2	
¾	22.4	
½	28.9	67.8%
¼	7.6	
⅛	2.7	10.3
10	5.7	5.7
20	3.4	
30	1.8	
40	0.9	6.1
50	2.9	2.9
80	0.9	
100	2.5	3.4
200	3.8	3.8
	100.0	100.0

Percentage of voids in Mineral Aggregate, 18.49.

Portland, Oregon, April 10, 1922.

LABORATORY REPORT No. P. H. 179.

Tests made to determine percentage of voids in mineral aggregate of P. A. 02266, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on October 10, 1919, and laid at Station 21 plus 15 on Green Springs Mountain Road—California line section of Pacific Highway.

Analysis of P. A. 02266.

Bitumen	6.1%	
Pass. 1¼″	15.6%	
1	20.8	
¾″	15.4	
½″	13.7	65.5%
¼	7.5	
⅛	2.9	10.4
10	5.6	5.6
20	3.3	
30	2.4	
40	1.4	7.1
50	3.9	3.9
80	1.4	
100	3.2	4.6
200	2.9	2.9
	100.0	100.0

Percentage of voids in Mineral Aggregate, 15.89.

Portland, Oregon, April 10, 1922.

LABORATORY REPORT No. P. H. 178.

Tests made to determine percentage of voids in mineral aggregate of P. A. 02114, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on October 6, 1919, and laid at Station 41 plus 50 on Green Springs Mountain Road—California line section of Pacific Highway.

Analysis of P. A. 02114.

Bitumen		6.0%	
Pass.	1¼″	14.9%	
"	1	19.6	
"	¾	14.0	
"	½	9.8	58.3%
"	¼	8.2	
"	⅛	3.0	11.2
"	10	7.1	7.1
"	20	4.6	
"	30	3.2	
"	40	1.8	9.6
"	50	4.5	4.5
"	80	1.5	
"	100	3.8	5.3
"	200	4.0	4.0
		100.0	100.0

Percentage of voids in Mineral Aggregate, 14.62.

Portland, Oregon, April 10, 1922.

LABORATORY REPORT No. P. H. 177.

Tests made to determine percentage of voids in mineral aggregate of P. A. 02004, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on September 30, 1919, and laid at Station 67 plus 75 on Green Springs Mountain Road—California line section of Pacific Highway.

Analysis of P. A. 02004.

Bitumen		5.9%	
Pass.	1½"	3.4%	
"	1¼	12.8	
"	1	23.4	
"	¾	13.7	
"	½	13.6	66.9%
"	¼	7.7	
"	⅛	3.2	10.9
"	10	5.0	5.0
"	20	2.9	
"	30	1.7	
"	40	1.0	5.6
"	50	3.7	3.7
"	80	1.6	
"	100	2.2	3.8
"	200	4.1	4.1
		100.0	100.0

Percentage of voids in Mineral Aggregate, 17.87.

Portland, Oregon, April 10, 1922.

LABORATORY REPORT No. P. H. 176.

Tests made to determine percentage of voids in mineral aggregate of P. A. 01879, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on September 23, 1919, and laid at Station 86 plus 00 on Green Springs Mountain Road—California line section of Pacific Highway.

Analysis of P. A. 01879.

Bitumen		6.2%	
Pass.	1¼″	7.3%	
"	1	13.8	
"	¾	15.8	
"	½	17.0	53.9%
"	¼	10.0	
"	⅛	3.4	13.4
"	10	9.5	9.5
"	20	4.9	
"	30	2.7	
"	40	1.5	9.1
"	50	3.8	3.8
"	80	1.2	
"	100	3.3	4.5
"	200	5.8	5.8
		100.0	100.0

Percentage of voids in Mineral Aggregate, 16.14.

Portland, Oregon, April 10, 1922.

LABORATORY REPORT No. P. H. 175.

Tests made to determine percentage of voids in mineral aggregate of P. A. 01810, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on September 18, 1919, and laid at Station 487 on Green Springs Mountain Road—California line section of Pacific Highway.

Analysis of P. A. 01810.

Bitumen		6.7%	
Pass.	1½″	0.0%	
"	1¼	3.2	
"	1	8.6	
"	¾	22.0	
"	½	22.8	56.6%
"	4	9.0	
"	8	3.2	12.2
"	10	7.3	7.3
"	20	4.4	
"	30	2.6	
"	40	1.7	8.7
"	50	4.5	4.5
"	80	1.8	
"	100	4.2	6.0
"	200	4.7	4.7
		100.0	100.0

Percentage of voids in Mineral Aggregate, 15.45%.

Portland, Oregon, April 10, 1922.

LABORATORY REPORT No. P. H. 174.

Tests made to determine percentage of voids in mineral aggregate of P. A. 01701, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on September 13, 1919, and laid at Station 532 plus 25 on Green Springs Mountain Road—California line section of Pacific Highway.

Analysis of P. A. 01701.

Bitumen		6.1%	
Pass.	1½"	0.0%	
"	1¼	8.2	
"	1	9.5	
"	¾	15.7	
"	½	19.2	52.6%
"	¼	9.9	
"	⅛	3.9	13.8
"	10	9.6	9.6
"	20	4.8	
"	30	2.6	
"	40	2.2	9.6
"	50	3.0	3.0
"	80	2.9	
"	100	4.2	7.1
"	200	4.3	4.3
		100.0	100.0

Percentage of voids in Mineral Aggregate, 17.46.

Portland, Oregon, April 10, 1922.

LABORATORY REPORT No. P. H. 173.

Tests made to determine percentage of voids in mineral aggregate of P. A. 01587, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on September 6, 1919, and laid at Station 517 plus 00 on Green Springs Mountain Road—California line section of Pacific Highway.

Analysis of P. A. 01537.

Bitumen	6.6%	
Pass. 1½	4.7%	
" 1¼	0.0	
" 1	3.8	
" ¾	13.4	
" 2	25.4	47.3%
" 4	13.5	
" 8	5.5	19.0
" 10	9.6	9.6
" 20	4.4	
" 30	2.0	
" 40	2.9	9.3
" 50	3.8	3.8
" 80	1.4	
" 100	4.2	5.6
" 200	5.4	5.4
	100.0	100.0

Percentage of voids in Mineral Aggregate, 17.76.

Portland, Oregon, April 10, 1922.

LABORATORY REPORT No. P. H. 172.

Tests made to determine percentage of voids in mineral aggregate of P. A. 01544, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on September 2, 1919, and laid at Station 498 plus 75 on Green Springs Mountain Road—California line section of Pacific Highway.

Analysis of P. A. 01544.

Bitumen		6.2%	
Pass.	1¼	3.1%	
"	1	5.8	
"	¾	16.3	
"	½	26.5	51.7%
"	4	9.6	
"	8	4.4	14.0
"	10	7.7	7.7
"	20	4.6	
"	30	2.7	
"	40	2.1	9.4
"	50	4.8	4.8
"	80	2.5	
"	100	4.8	7.3
"	200	5.1	5.1
		100.0	100.0

Percentage of voids in Mineral Aggregate, 16.55.

Portland, Oregon, April 10, 1922.

LABORATORY No. P. H. 171.

Tests made to determine percentage of voids in mineral aggregate of P. A. 01266, which showed analysis given below and which was an uncompressed sample of Bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson County, Oregon, on August 19, 1919, and laid at Station 443 on Green Springs Mountain Road—California line section of Pacific Highway.

Analysis of P. A. 01266.

Bitumen	5.9%	
Pass. 1½	4.6%	
" 1¼	2.5	
" 1	12.6	
" ¾	22.0	
" ½	24.7	66.4%
" 4	7.1	
" 8	3.8	10.9
" 10	6.2	6.2
" 20	3.3	
" 30	1.0	
" 40	2.4	6.7
" 50	3.0	3.0
" 80	1.3	
" 100	3.0	4.3
" 200	2.5	2.5
	100.0	100.0

Percentage of voids in mineral aggregate, 1903.

P H 183

Lab. No. P. A. 02810
Filter
Mixture
Total
After Extr.
Net.

		%	Grams.
Pass	1½		
Pass	1¼	12.7	762
"	1	16.0	960
"	¾	22.1	1326
"	2	14.1	846
"	4	6.8	408
"	8	2.4	144
"	10	5.9	354
"	20	3.4	204
"	30	2.4	144
"	40	1.9	114
"	50	3.4	204
"	80	1.6	96
"	100	3.3	198
"	200	4.0	240
		100.0	6000

Void Test

Spec. Grav. material used:

.741 × 2.84 = 2.104√
.259 × 2.75 = .712
Spec. Grav. 2.816√

Weight of cone	4365
" " " full water	6641
Capacity	2276√
Contents of no voids	6409√
Weight of cone full of Min. Agg.	9620
Min. Agg.	5255√
Voids	1154√
% "	18.01√

Lab. No. P. A. 02649
Filter
Mixture
Total
After Extr.
Net.

		%	Grams.
Pass	1½		
Pass	1¼	18.0	1080
"	1	16.0	960
"	¾	13.2	792
"	2	12.1	726
"	4	7.5	450
"	8	3.4	204
"	10	7.2	432
"	20	4.3	258
"	30	2.9	174
"	40	1.9	114
"	50	4.1	246
"	80	1.6	96
"	100	4.0	240
"	200	3.8	228
		100.0	6000

Void Test

Spec. Grav. materials used:

.702 × 2.84 = 1.994√
.298 × 2.74 = .816
Spec. Grav. 2.810√

Weight of cone	4364
" " " full water	6640
Capacity	2276
Contents if no voids	6395√
Weight of cone full of Min. Agg.	9740
Min. Agg.	5376√
Voids	1019√
% "	15.93√

P H 181

Lab. No. P. A. 02501
Filter
Mixture
Total
After Extr.
Net.

		%	Grams.
Pass	1½	1.5	90
Pass	1¼	10.0	600
"	1	22.9	1374
"	¾	14.6	876
"	2	10.5	630
"	4	7.5	450
"	8	3.4	204
"	10	8.0	480
"	20	5.2	312
"	30	3.3	198
"	40	2.0	120
"	50	3.9	234
"	80	1.6	96
"	100	3.2	192
"	200	2.4	144
		100.0	6000

Void Test

Spec. Grav. material used:

.704 × 2.84 = 1.999√
.296 × 2.75 = .814√
Spec. Grav. 2.813√

Weight of cone	4364
" " " full of water	6640
Capacity	2276
Contents if no voids	6402√
Weight of cone full of Min. Agg.	9750
Min. Agg.	5386√
Voids	1016√
% "	15.87√

Lab. No. P. A. 02374
Filter
Mixture
Total
After Extr.
Net.

		%	Grams.
Pass	1½		
Pass	1¼	4.3	258
"	1	12.2	732
"	¾	22.4	1344
"	2	28.9	1734
"	4	7.6	456
"	8	2.7	162
"	10	5.7	342
"	20	3.4	204
"	30	1.8	108
"	40	0.9	54
"	50	2.9	174
"	80	0.9	54
"	100	2.5	150
"	200	3.8	228
		100.0	6000

Void Test

Spec. Grav. material used:
.781 × 2.84 = 2.218√
.219 × 2.75 = .602√
Spec. Grav. 2.820√

Weight of cone	4364
" " " full water	6640
Capacity	2276
Contents if no voids	6418√
Weight of cone full of Min. Agg.	9595
Min. Agg.	5231√
Voids	1187√
% "	18.49√

P H 179

Lab. No. P. A. 02266
Filter
Mixture
Total
After Extr.
Net.

		%	Grams.
Pass.	1½		
Pass	1¼	15.6	936
"	1	20.8	1248
"	¾	15.4	924
"	2	13.7	822
"	4	7.5	450
"	8	2.9	174
"	10	5.6	336
"	20	3.3	198
"	30	2.4	144
"	40	1.4	84
"	50	3.9	234
"	80	1.4	84
"	100	3.2	192
"	200	2.9	174
		100.0	6000

Void Test

Spec. Grav. material used:
.759 × 2.83 = 2.148√
.241 × 2.75 = .663√
Spec. Grav. 2.811√

Weight of cone	4364
" " " full water	6640
Capacity	2276
Contents if no voids	6398√
Weight of cone full of Min. Agg.	9745
Min. Agg.	5381√
Voids	1017
% "	15.89√

Void Test

Spec. Grav. material used:

Lab. No. P. A. 02114

Filter .695 × 2.84 = 1.974√

Mixture .305 × 2.75 = .839√

Total Spec. Grav. 2.813√

After Extr.			%	Grams.		
Net.	Pass	1½			Weight of cone	4364
	Pass	1¼	14.9	894	" " " full water	6640
	"	1	19.6	1176	Capacity	2276
	"	¾	14.0	840	Contents if no voids	6402√
	"	2	9.8	588	Weight of cone full of Min. Agg.	9830
	"	4	8.2	492	Min. Agg.	5466
	"	8	3.0	180	Voids	936

" 10	7.1	426	% "	$14.62\sqrt{}$
" 20	4.6	276		
" 30	3.2	192		
" 40	1.8	108		
" 50	4.5	270		
" 80	1.5	90		
" 100	3.8	228		
" 200	4.0	240		
	100.0	6000		

P H 177

Void Test

Lab. No. P. A. 02004

Filter

Mixture

Total

After Extr.

Net.

Pass	1½	3.4	204
Pass	1¼	12.8	768
"	1	23.4	1404
"	¾	13.7	822
"	2	13.6	816
"	4	7.7	462
"	8	3.2	192

Spec. Grav. material used:

.778 × 2.84 = 2.210√

.222 × 2.75 = .610√

Spec. Grav. 2.820√

Weight of cone	4364
" " " full water	6640
Capacity	2276
Contents if no voids	6418√
Weight of cone full of Min. Agg.	9635
Min. Agg.	5271
Voids	1147

17.87 V

" 10	5.0	300	%	"
" 20	2.9	174		
" 30	1.7	102		
" 40	1.0	60		
" 50	3.7	222		
" 80	1.6	96		
" 100	2.2	132		
" 200	4.1	246		
	100.0	6000		

Lab. No. P. A. 01879

Filter

Mixture

Total

After Extr.

Net.

Pass	1½		
Pass	1¼	7.3	438
"	1	13.8	828
"	¾	15.8	948
"	2	17.0	1020
"	4	10.0	600
"	8	3.4	204

Void Test

Spec. Grav. material used:

.673 × 2.84 = 1.911√

.327 × 2.75 = .899√

Spec. Grav. 2.810√

Weight of cone	4364
" " " full water	6640
Capacity	2276
Contents if no voids	6395√
Weight of cone full of Min. Agg.	9727
Min. Agg.	5363
Voids	1032

" 10	9.5	570	%	"	$16.14\sqrt{}$
" 20	4.9	294			
" 30	2.7	162			
" 40	1.5	90			
" 50	3.8	228			
" 80	1.2	72			
" 100	3.3	198			
" 200	5.8	348			
	100.0	6000			

Lab. No. P. A. 01810
Filter
Mixture
Total
After Extr.

Net.			%	Grams.
	Pass	1½		
	Pass.	1¼	3.2	192
	"	1	8.6	516
	"	¾	22.0	1320
	"	2	22.8	1368
	"	4	9.0	540
	"	8	3.2	192

Void Test
Spec. Grav. material used:
.688 × 2.84 = 1.954√
.312 × 2.75 = .858√
Spec. Grav. 2.812√

Weight of cone	4364
" " " full water	6640
Capacity	2276
Contents if no voids	6400√
Weight of cone full of Min. Agg.	9775
Min. Agg.	5411
Voids	989

15.45 √

" 10	7.3	438	%	"
" 20	4.4	264		
" 30	2.6	156		
" 40	1.7	102		
" 50	4.5	270		
" 80	1.8	108		
" 100	4.2	252		
" 200	4.7	282		
	100.0	6000		

Lab. No. P. A. 01701
Filter
Mixture
Total
After Extr.
Net.

		%	Grams.
Pass	1½		
Pass	1¼	8.2	492
"	1	9.5	570
"	¾	15.7	942
"	2	19.2	1152
"	4	9.9	594
"	8	3.9	234
"	10	9.6	576

Void Test

Spec. Grav. material used:

.664 × 2.84 = 1.886√

.336 × 2.75 = .924√

Spec. grav. 2.810√

Weight of cone	4363
" " " full water	6639
Capacity	2276
Contents if no voids	6395√
Weight of cone full of Min. Agg.	9641
Min. Agg.	5278
Voids	1117
% "	17.46√

" 20	4.8	288
" 30	2.6	156
" 40	2.2	132
" 50	3.0	180
" 80	2.9	174
" 100	4.2	252
" 200	4.3	258
	100.0	6000

Void Test

Lab. No. P. A. 01587

Filter

Mixture

Total

Spec. Grav. material used:

.663 × 2.84 = 1.883√

.337 × 2.74 = .923√

Spec. Grav. 2.806√

After Extr.			%	Grams.		
Net.	Pass	1½	4.7	282	Weight of cone	4365
	Pass	1¼	0.0	00	" " " full water	6641
	"	1	3.8	228	Capacity	2276
	"	¾	13.4	804	Contents if no voids	6386√
	"	2	25.4	1524	Weight of cone full of Min. Agg.	9617
	"	4	13.5	810	Min. Agg.	5252
	"	8	5.5	330	Voids	1134

17.76√

" 10	9.6	576	% "
" 20	4.4	264	
" 30	2.0	120	
" 40	2.9	174	
" 50	3.8	228	
" 80	1.4	84	
" 100	4.2	252	
" 200	5.4	324	
	100.0	6000	

Lab. No. P. A. 01544
Filter
Mixture
Total
After Extr.
Net.

		%	Grams.
Pass	1½		
Pass	1¼	3.1	186
"	1	5.8	348
"	¾	16.3	978
"	2	26.5	1590
"	4	9.6	576
"	8	4.4	264

Void Test
Spec. Grav. material used:
.657 × 2.84 = 1.866√
.343 × 2.75 = .943√
Spec. Grav. 2.809√

Weight of cone	4365
" " " full water	6641
Capacity	2276
Contents if no voids	6393√
Weight of cone full of Min. Agg.	9700
Min. Agg.	5335
Voids	1058

" 10	7.7	462	%	"	16.55√
" 20	4.6	276			
" 30	2.7	162			
" 40	2.1	126			
" 50	4.8	288			
" 80	2.5	150			
" 100	4.8	288			
" 200	5.1	306			
	100.0	6000			

Analysis of
Lab. No. P. A. 01266
Filter
Mixture
Total
After Extr.

			%	Grams.
Net.	Pass	1½	4.6	276
	Pass	1¼	2.5	150
	"	1	12.6	756
	"	¾	22.0	1320
	"	2	24.7	1482
	"	4	7.1	426
	"	8	3.8	228

Void Test
Spec. Grav. material used:
.773 × 2.84 = 2.195√
.227 × 2.75 = .624√
Spec. Grav. 2.819√

Weight of cone	4365
" " " full water	6641
Capacity	2276
Contents if no voids	6416√
Weight of cone full of Min. Agg.	9560
Min. Agg.	5195
Voids	1221

" 10	6.2	372	% "	19.03√
" 20	3.3	198		
" 30	1.0	60		
" 40	2.4	144		
" 50	3.0	180		
" 80	1.3	78		
" 100	3.0	180		
" 200	2.5	150		
	100.0	6000		

% voids in Min. Agg.....19.03

Tests made to determine percentage of voids in mineral aggregate of P. A. 01266 which showed analysis given below and which was an uncompressed sample of bitulithic mixture taken from a load of same mixed at Oskar Huber's plant in Jackson Co., Ore., on Aug. 19, 1919, and laid at sta— on Green Springs Mountain Road—Calif. line section of Pac. Highway.

Plaintiff's Exhibit No. 21.

HERE IS THE REPORT.

Hon. C. C. Colt, President,
Portland Chamber of Commerce.

Your committee, to whom was referred for report and recommendation the public contracts which will be let relative to the bond issue recently passed for good roads, begs to report as follows:

TOOK STENOGRAPHIC NOTES.

Your committee first met on the 28th day of April and decided that it would be a wise procedure to institute a series of hearings at which stenographic notes be taken for the purpose of extending the same in transcript form for present and future reference. It was thought that in this way your committee would establish an orderly procedure for giving opportunity to anyone who might desire to present themselves and state their qualifications and views on the general subject of highway construction.

VISITED PAVEMENTS.

These hearings were supplemented by an investigation of pavements and highways within the city limits of Portland and contiguous thereto, as well as visits to chemical laboratories where pavements are subjected to various tests to ascertain whether they conform to established standards.

In this way your committee feels that it has approached and investigated the subject in as comprehensive a manner as the limited time placed at its disposal would permit. Attached to this

report and made a part hereof is a copy of the transcript of the testimony taken by your committee.

NO NEED TRAVEL FAR.

In it is personal inspection of pavements of the city of Portland and vicinity, your committee arrived at the conclusion that it was not necessary to visit any other community to ascertain the behavior of all forms of hard surface pavements under traffic conditions, for your committee was able to find in Portland and its vicinity all of the standard hard surface types of pavement being actually subjected to daily traffic and weather conditions.

There is this much to say with reference to the construction of permanent county roads as distinguished from city pavements—in county road construction opposite lines of travel are confined to a relative small area of surface. This is due to the fact that county road construction usually varies in width from 12 to 20 feet, as far as hard surfacing is concerned, while in city pavements opposite lines of travel are spread over a greater area, the width of hard surfaced streets being generally wider than country highways.

PROBLEM DIFFERS FROM CITY.

The result of this is that there is a concentration of the lines of travel upon a country highway that does not exist in city streets.

The next difference between country highways and city streets is this—that upon the question of

repair the problem is a different one with reference to the country road than to the city street.

LONG WAY FROM PLANT.

A country road is apt to be, on an average, a greater distance from the base of the supply of repairing material than is a city street. The result of this is that there is an increase of the unit cost of repair upon a country road over that of the city pavement.

TRAFFIC INTERRUPTIONS.

Another distinction is this—that in the repair of the hard surfaced city street, during the time of repair, traffic may be diverted to parallel streets within a short distance of the street to be repaired, which can, without any great inconvenience, reach the almost identical territory which is served by the street under repair, while on the country highway the interruption to traffic for the purpose of the repair is apt to inconvenience a territory that is not otherwise served.

TAKES LONGER TO CLEAN.

Another important factor in a comparative sense is the facility and opportunity for cleaning highways and city streets. With reference to the cleansing of the city street, cities usually maintain efficient cleaning departments with comparatively low cost, owing to a sufficient number of hard surfaced pavements, allowing cleaning to be done upon both the out-going and returning trip.

Ordinarily in the cleaning of a country road there is a large loss of time for the cleaning apparatus in returning from the end of the clean-

ing trip to the base of operation. This may be somewhat mitigated if country highways are constructed along the lines of complete out-going and returning circulation. However, it is not reasonable to expect that as efficient a country cleaning force can be maintained as is maintained in the city. It is neither desirable or necessary if the type of pavement is chosen for country highways whose life is not vitally dependent upon its being kept clean.

SHOWS BASIS COMPARISON.

The effect of the above distinctions is that with reference to country highways a city pavement, particularly in regard to its life and cost of maintenance, is not an absolute criterion for a country road type. It is a criterion, however, for the purpose of ascertaining the behavior of various types of pavement under weather and traffic conditions.

There is another distinction which might be made between a city pavement and a country road, and that is this—generally, adjacent to a roadway devoted to general vehicle traffic is a sidewalk for pedestrians, which is separated from the roadway area by a substantial curb, while the country roads have made a practice, from the standpoint of economy, of having the hard surface area of less width than the right of way of the road.

In such construction, ordinarily the roadway is not divided by a substantial curb, but there is a construction, a shoulder generally, of macadam which furnishes a width of road on which traffic

may pass or turn. The junction of the hard surfaced part of the road with the macadam next to it introduces a road problem that is not generally met in the city street.

NOT CUT UP SO OFTEN.

On the other hand, the most trying problems of the city pavement are not often met with in country road construction; they are the continually cutting in of the pavement of the city street for the purpose of getting at pipes and wires and the establishing in city streets of auxiliary furniture, generally in the way of catch basins and man-holes; and the laying of hard surfaced pavement adjacent to street railroad tracks.

It has been found that many city pavements that were otherwise good, have failed owing to these complications; therefore, the fact that a city pavement does not fail otherwise than above specified would seem to commend it for use upon country roads.

DISCUSSES LEGAL STATUS.

At this point it might be well to make reference to the principal sources of statutory law under which Multnomah County must look for the construction of its contemplated highway system under the $1,250,000 bond issue recently authorized.

The principal statute on the subject is Chapter 103 of the Laws of 1913, found on page 170 *et seq.* of the General Laws of Oregon for 1913. Under this law, after the fourth year until the maturity of the bonds, the law requires that a specified amount be set aside, the object being to retire the bonds

serially at the end of the 15 years the county will have retired its indebtedness created for road construction. It therefore seems advisable that the kind of pavement be selected which, with a reasonable amount expended for maintenance, will insure a condition of the road as good at the time the bonds are retired as it was at the date of construction.

MINIMUM, 15 YEARS LIFE.

In other words, it would be extremely poor public finance to have the road system in such a state of dis-repair prior to the time all bonds are retired, as to be, for all practical purposes, useless. Therefore, 15 years should be required as the minimum life of any road system constructed under the 15 year bond issue.

Returning again to Chapter 103 of the General Laws of 1913, your committee found that in a good many instances the law is somewhat indefinite, but as this developed points of construction applied to matters that occurred before the authorization of the bond issue by election, and are of an immaterial nature, your committee refrains from giving consideration to most of them.

At this stage of the road development, however, there are two sections of the law that should be discussed. They are Sections 13 and 24. Section 13 is as follows:

> "All monies raised under the provisions of this act shall be used in constructing permanent public roads in that county, which roads shall be constructed by the county court under its exclusive jurisdiction and such expert assistance

as they may employ." Section 24—"The County Court shall prepare plans and specifications of said road and shall invite bids in conformity to such plans and specifications, and may also receive and consider any and all bids in conformity to any plans and specifications furnished by any individual, firm or corporation offering to bid on such roads. The County Court shall have power to reject any and all bids."

In legal parlance it may be stated that these two sections of the road law become the subject of construction. This is true because there is a possibility of a conflict between the provisions of one, when considered with reference to the provisions of the other. A general rule of construction of statutory law requires that statutes, or sections of the same statute that seem to be in conflict should be reconciled if possible. That is to say that in this particular case, if the two sections are subject to a construction that makes one in conflict with the other, and also a construction that will reconcile one with the other, the rule is that the one that reconciles them is the governing rule of construction.

The possible conflict between Sections 13 and 24 is this—that if the sense of Section 13 be taken standing alone it would seem to indicate that the County Court is given authority under the law to purchase material and employ labor and expert assistance for the construction of county roads. While, if Section 24 is taken by itself, it would

seem to indicate that the authority of the County Court is limited to the preparation of plans and specifications and thereafter must receive bids for the construction of roads by contractors. However, if the general rule of law be followed, which your committee thinks of necessity must be the construction that could be placed upon these two sections is this—that in the first instance the County Court must cause plans and specifications to be prepared.

In the preparation of this work, under Section 13, it would have authority to employ expert assistance; that the plans and specifications must be published and bids received. The right is reserved, however, to the County Court to reject any and all bids. If it accepts a bid, then, under Section 13, it would have authority to employ such expert assistance in the way of inspection and otherwise as would insure a proper conformity by the contractor of his contract.

But Section 24 must be given consideration over and above its possible construction with Section 13, and that is this—under Section 24 the County Court does not seem to be under the necessity to make its award to the lowest responsible bidder bidding on the same type of pavement. Authority under this section is also given to the County Court to reject all bids. The law however—that is, Chapter 103—is silent as to what procedure the County Court may follow in case all bids are rejected. The law seems neither to contemplate that the County Court may re-advertise for bids

or to proceed to construct the road by the purchase of material and the employment of labor.

This being so, your committee is of the opinion that the law with reference to this subject must be found elsewhere, possibly among the general statutes of the state with reference to the power and jurisdiction of the County Court to construct roads. Further, the statute being silent as to what procedure may be followed in case all bids are rejected, your committee is of the opinion that Section 25 of Chapter 103 would not act as a repealing clause against any general road statute which dealt with the special matter of the power of the county with reference to roads in a case where all bids were rejected. Your committee has not had time to investigate the general road statutes with reference to this subject, but in its investigations it was brought out by Mr. E. E. Coovert, an expert lawyer on the subject of road law, that in his opinion in many particulars the general road law and other statutes should be construed as supplementing Chapter 103 of the laws of 1913.

BUILD BY DAY LABOR.

A proposition has been brought to the attention of your committee by Messrs. McMullen and Dulin that they stand ready to enter into a contract with the county by which the county is to construct the contemplated road system by the purchase of material and the employment of labor.

LABOR COUNCIL SUPPORTS PLAN.

These gentlemen have submitted a proposition to the county under the date of April 21st, 1915, sup-

plemented by a further communication, copies of which are hereto attached and for better reference are marked Exhibit A.

Their plan is that the county establish a paving plant at Kelly Butte and control the mixing and laying of the pavement, the county to pay all expenses of running the plant and labor incident to the mixing and laying, these gentlemen to act as expert assistants to the county for which they would receive a compensation of $200 per month.

CLAIM 60¢ COST.

It is their claim that they can lay types of bituminous pavement at a cost to the county of less than 60 cents per square yard, not taking into consideration the cost of royalty if the county decides to hard surface the system of county roads or any portion thereof by using a patent pavement. That, in addition to their compensation of $200 per month each for their services, they receive a bonus equal to thirty-three and a third (33⅓) per cent of the amount saved by laying such pavement at less than 60 cents per yard; their proposition providing that none of this bonus shall be paid to them at the completion of the pavement but shall remain in trust for five years.

IS INGENIOUS PROPOSAL.

If, during that period, any defects appear in the pavement as laid there shall be deducted from the bonus an amount sufficient to defray all expenses of repairing pavement, and only the amount

remaining in the bonus after repairs have been made shall be paid to them.

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This presents an interesting proposition.

ARE CHEMICAL EXPERTS

Your committee held conference with Messrs. McMullen and Dulin and visited the paving testing laboratory of the city of Portland where these gentlemen are at the present time employed.

HONEST AND SINCERE.

All the members of your committee became profoundly impressed with the knowledge that these gentlemen possess with reference to the physical and chemical properties of pavements.

Your committee was further impressed with the honesty and sincerity of these gentlemen.

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Incidentally, throughout these hearings paving contractors were interrogated with reference to the cost items presented in the communications of Messrs. McMullen and Dulin.

FIGURES SEEM TOO LOW.

Where these interrogations were made the answers were that the figures of Messrs. McMullen and Dulin were too low; that they had failed to take into consideration certain overhead and depreciation expenses.

Undoubtedly, in a measure, this criticism is correct, but our investigations also led us to the conclusion that certain items which contractors habitually include as cost items, while legitimate in the general paving business, would not and should not be considered if the county were to employ

labor, purchase material and directly construct the road system.

These items principally concern themselves with what might generally be called items of sales expense. A contractor or a paving company must of necessity be brought in competition with other types of pavement, and in order to get the business an efficient and intelligent sales department must be maintained.

This is usually a high salaried department, because it requires exceedingly clever men—men convincing, persuasive, honest and possessing a profound knowledge of the details of the paving business. This, we say, would not apply to the county after it once settles the type of pavement that it desires to construct. There is an element, however, that enters into the cost items of construction possibly not contemplated by Messrs. McMullen and Dulin, and that is this:

That the success of most types of pavement depends upon the skill and accuracy in preparing the preparation and laying it upon the roadbed.

COST OF MAINTAINING ORGANIZATION.

That in order to command the services of the best skill in this respect it is necessary to carry on the payrolls of whoever is constructing a pavement these skilled employees over a period of time when seasonal conditions prevent paving construction.

It goes without saying, of course, that if the county were to enter into general hard surface road construction it would eliminate contractors'

profits in road construction. The county, however, as well as any contractor, would have to meet royalty payments if it decided to use a patent pavement, assuming, of course, that the patent to the pavement is sustainable.

DANGER POLITICAL INTERFERENCE.

As against this item of the contractor's profit, however, is the danger of political interference in road construction by the county. Your committee does not wish to be understood to imply or intimate that there is political influence existing at the present time with reference to the road system of the county as administered by the Board of County Commissioners. In fact, your committee knows of no such influence, and does not wish to infer that any exists. But, it does say that this danger is one that has arisen where construction is done directly by public authority, and, therefore, the danger might confront us in the future.

NOT FREE FROM DOUBT.

It is the understanding of your committee that the Board of County Commissioners has rejected the proposition of Messrs. McMullen and Dulin. Your committee also desires to state that their proposition is not free from doubt as a legal question. Your committee will not and does not say that their proposition could be accepted by the county as a matter of law or that it could not be accepted as a matter of law.

PORTABLE PLANT SUGGESTED.

Objection has been urged to their proposition on the ground that a $50,000 plant at Kelly Butte could not furnish the facility for material for the contemplated road construction on two grounds—first, that the material could not be turned out fast enough; second, that in order to economically construct all the portions of the road system portable plants must be established to furnish a near base of supply.

To this Messrs. McMullen and Dulin answer that at a very low cost the county could establish the portable plants suggested. It is also urged that, without an undue expenditure of money for equipment, the county would be unable to hard surface the road system contemplated within a reasonable length of time; while under the contract system, if work were let to a responsible contractor, he could bring to bear upon the work sufficient equipment to rapidly perform the work, due to the fact that his plant has already been assembled in his contracting business and after the completion of the contract he would have reasonable prospect of employing his plant in his general business.

COUNTY PLANT IDLE.

While in the plant of the county, unless the county were to continue in blocks of work equal to or nearly equal to the present block of hard surface construction—in other words, inasmuch as probably during the first five years of the pavement the repairs would be slight, there would be little use for large equipment; much of the equip-

ment would be idle unless the electors of the county authorized large future bond issues, and it is undoubtedly true, considering the problematical utility of a large county equipment, that the county would have to carry a disproportionate depreciation account on its plants, both fixed and portable.

There is some tendency for cities and counties to maintain their own paving plants. It may be said, however, that this question is one on which, as a policy, there is a considerable divergence of opinion. In a measure Multnomah County now maintains such a system with reference to the macadamizing of the present county roads, and we understand that Pierce County, Wash., partially maintains such a system, or has done so while constructing its cement roads, in order that its roads may be supplied with properly selected and washed sand, gravel and broken stone.

QUESTION OF PUBLIC POLICY.

In conclusion, on this point your committee is of the opinion that the items of road cost do not lie entirely in Messrs. McMullen's and Dulin's figures, nor do they lie entirely with the cost items of contractors. They seem to repose somewhere as a middle ground between the two, and your committee feels that the general membership of the Chamber or its Board of Directors is fully capable of deciding for itself whether the work shall be done under the contract system or under direct construction by the county; for, after all,

it is a question of policy upon which public and individual opinion is divided.

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WHAT ARE FUNDAMENTAL REQUIREMENTS?

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Your committee now comes to the point in its report in which it approaches the question of desirability of pavement.

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In order that pavements may be classified, an outline of just what requirements a pavement should conform to seems desirable. After this has been ascertained, the prevailing types of hard surface pavements should be subjected to an analysis in order that it may be ascertained which of the pavements contains most of the elements of desirability. The best discussion of the subject under present consideration that your committee has been able to find appears in "Bryne on Highway Construction," the fifth and latest edition, which was issued in 1913. We have found the discussion of this author so good that we must be pardoned for quoting rather heavily from his opinions. On page 1 he says:

> THESE QUALITIES ESSENTIAL.
>
> The qualities essential to a good pavement may be stated as follows:
>
> No. 1—It should be impervious.
>
> No. 2—It should afford good foothold for horses.
>
> No. 3—It should be hard and durable, so as to resist wear and disintegration.

No. 4—It should be adapted to every grade.

No. 5—It should suit every class of traffic.

No. 6—It should offer the minimum resistance to traffic.

No. 7—It should be noiseless.

No. 8—It should yield neither dust nor mud.

No. 9—It should be easily cleaned.

No. 10—It should be cheap.

Continuing, he says:

Of the above requirements No. 2, 4, 5 and 6 affect traffic and determine the cost of haulage by the limitation of loads, speed, wear and tear of horses and vehicles.

If the surface is rough or the foothold bad the weight of the load a horse can draw is decreased, thus necessitating the making of more trips or the employment of more horses and vehicles to move a given weight.

A defective surface necessitates a reduction in the speed of movement and consequent loss of time.

It measures the wear on horses, thus decreasing their life service and lessens the value of their current services.

It also increases the cost of maintaining vehicles and harness.

No. 7, 8, and 9 affect the occupiers of the adjacent premises, who suffer from the effect of dust and noise; and second, the owners of said premises whose incomes from rents is diminished when these disadvantages exist.

No. 3 and 10 affect the taxpayers alone; first as to length of time during which the covering

remains serviceable and second as to the amount of annual repairs.

No. 1 affects the adjacent occupiers principally on hygienic grounds.

No. 7 and 8 affect both traffic and occupier.

MOTORS NEW PROBLEM.

With reference to present traffic conditions and their application to county roads, the above essential qualifications of Bryne need modification. At the present time the large volume of traffic is moved by motor vehicles and this introduces a new traffic problem of its own, and minimizes the traffic problems of horse drawn vehicles.

MUST NOT IGNORE HORSES.

But, while this is so, horse traffic must not and cannot be ignored on county roads. The quality of a pavement being noiseless is not as necessary on a county road as on a city street, and its ease of being cleaned, except where dirt affects the life of the pavement, is not so important a country as a city problem, altho it cannot be entirely ignored in country construction. The element of cost is a more vital problem in the country road than in the city street, owing to the fact that in city streets the original cost of construction is usually charged to abutting property, and the improvement by hard surfacing and adjacent street represents a greater percentage of increased value to abutting property.

ELEMENT OF COST VITAL.

There is a tendency for city property to sell

more rapidly in small lots than there is for country property to so sell, and the street assessment represents a smaller element measured against property value in the city than the country. The result is that the city owner can more readily transfer the cost of the hard surfaced pavement assessed to abutting property while the country land owner cannot.

This applies more particularly where a country road is constructed under an assessment against abutting property; but, nevertheless, even where the county constructs directly it has an indirect bearing, inasmuch as the general tax is a more distasteful tax than an assessment for special benefits. Therefore, country road construction consistent with durability should be a cheaper pavement than a city pavement.

COMPARES COST OF HAULING.

On page 3 of the above cited authority is given a table which sets out the cost of transportation by horse and wagons per ton mile on different road coverings. The table is as follows:

Transportation on iron rails	1.28¢
On asphalt	2.70¢
On stone paving, dry and in good order	5.33¢
On stone paving, dry and in ordinary condition	.12¢
On stone paving, covered with mud	21.30¢
On earth, dry and hard	18.
On earth, full of ruts and mud	39.
On loose gravel	51.60¢
On gravel, compact	12.80¢

On plank in good condition..... 8.80¢
On sand, wet..... 32.60¢
On sand, dry..... 64.

On page 4 the author says:

> The problem involved in the selection of the most suitable pavement is composed of the following factors—first, adaptability; second, desirability; third, serviceability; fourth, durability; fifth, cost.

MUST FIT LOCAL USE.

Adaptability: Continuing the author says:

> The best pavement for any given roadway will depend altogether on local circumstances.
>
> Pavements must be adapted to the class of traffic that will use them. The pavement suitable for a road thru an agricultural district will not be suitable for the streets of a manufacturing center, nor will the covering suitable for heavy traffic be suitable for a pleasure drive or residential district.

MUST SATISFY USERS.

Desirability: With reference to this, he says:

> The desirability of a pavement is its possession of qualities which make it satisfactory to the people using and seeking it. Between two pavements alike in cost and in durability, people will have preferences arising from the condition of their health, personal prejudices, and various other intangible influences, causing them to select one rather than the other.
>
> The economic desirability of pavements is governed by the ease of movement over them,

and is measured by the number of horses or pounds of tractive force required to move a given weight, usually one ton, over them.

COMPARES HORSE EFFORT.

The author then gives a table for level roads, surface of which is formed of different materials, in which he takes asphalt as the standard of excellence. By this table he shows the number of horses required to move one ton over these different pavements. The table is as follows:

Asphalt	1.00
Stone blocks dry and in good condition	1.50 to 2.00
Stone blocks in fair condition	2.00 to 2.50
Stone blocks covered with mud	2.00 to 2.70
Macadam, dry and in good condition	2.50 to 3.00
Macadam, in a wet state	3.30
Macadam, in fair order	4.50
Macadam, covered with mud	5.50
Macadam, with stones loose	5.00 to 8.20

SMOOTHNESS IS ECONOMY.

From the above table the great economy of smoothness becomes at once apparent. But it is evident that, as in all lines of transportation, the greatest resistance regulates the load over the rest of the route, unless there be auxiliary power; so the continuity of the surface should remain unbroken by any other grade of material which would increase the resistance.

EXPENSE CAUSED TO TRAFFIC.

The author discusses serviceability as follows:

The serviceability of a pavement is its quality

of fitness for use. This quality is measured by the expense caused to the traffic using it.....No statistics are available from which to deduct the actual cost of wear and tear. It has been estimated as follows:

	Per Mile of Travel.
On cobblestones	5¢
Belgian blocks	4¢
Wood	2.5¢
Broken stone in first class condition	1.2¢
Asphalt	1¢

FOOTHOLD FOR HORSES.

The serviceability of any pavement depends in a great measure upon the amount of foothold afforded by it to the horses, provided, however, that its surface be not so rough as to absorb too large a percentage of the tractive energy required to move a given load over it. Cobblestones afford excellent foothold but the resistance to motion requires the expenditure of about 280 pounds of tractive energy to move a load of one ton. Asphalt affords the least foothold but the tractive force required to overcome the resistance it offers to motion is only about 30 pounds per ton.

WHEN HORSES FALL.

Comparative safety. The comparison of pavements in this respect is the distance traveled before a horse falls. The materials affording the best foothold for horses are as follows, stated in the order of their merit.

1. Earth dry and compact.
2. Gravel.
3. Macadam.
4. Wood.
5. Sandstone and brick.
6. Asphalt.

*7. Granite blocks.

HOW FAR HORSE WILL TRAVEL.

The author then gives a table showing how far a horse will travel over the various pavements, which was worked out by Capt. F. B. Greene, and it is as follows:

Asphalt	583 miles
Granite	413 miles
Wood	272 miles

HAYWOOD FAVORS WOOD.

For the same purpose observations were made in London by Col. Haywood. He compared wood, asphalt and stone under conditions as nearly identical as possible. The observation was for fifty days, and it showed that before meeting with an accident a horse would travel a greater distance on wood than he could either on asphalt or stone. Col. Haywood's table is as follows:

WEATHER AFFECTS HORSE SAFETY.

Dry Weather Distances.

Wood	646 miles
Asphalt	223 miles
Granite	78 miles

*Note—Committee's explanation, not given by author, this would include Belgian blocks.

Damp Weather Distances.

Wood	193 miles
Asphalt	125 miles
Granite	168 miles

Thoroughly Wet Weather.

Wood	432 miles
Asphalt	192 miles
Granite	537 miles

Under another mode of observation the distance may be given as follows:

Wood	446 miles
Asphalt	191 miles
Granite	132 miles

COMPARES SLIPPERYNESS.

It thus appears, from the above tables, that asphalt is the most slippery when damp and safest when perfectly dry; granite slippery when dry and safest when wet; wood most slippery when damp, safest when dry.

STONE BLOCKS SAFEST.

When climatic conditions of Western Oregon are considered, granite or Belgian blocks being slippery when perfectly dry but safe when perfectly wet, stone blocks must be considered the safest pavement, and that as between asphalt and wood, wood is the safest. Granite seems to be least safe when clean and wood and asphalt most safe when clean. Slight rains make asphalt and wood more slippery than they do at other times. Asphalt becomes slippery almost at once after a slight rain, while wood requires more rain, before it

reaches its worst condition, but slipperiness lasts longer on wood.

It will be noted in the above that the tables of Greene and Haywood differ, Greene's table having been taken in the eastern cities of America and Haywood's with reference to the London pavements. Probably climatic conditions explain the difference in the two tables.

HOW TO OVERCOME.

There is also another explanation for the behavior of asphalt, and that is that the asphalt as laid in Europe is a more slippery pavement, owing to the methods of its construction, than the asphalt laid in the United States. The authorities seem to agree that slipperiness can be cured in asphalt by the spreading of sand, and on wood block pavements by the spreading of pea gravel and the rolling of the same over the surface by a steam roller.

DIFFERENCE IN FALLS.

On page 21 of his work on Highway Construction, Bryne discusses the character of falls on various pavements as follows:

> The commonest falls on wood are falls on the knees, which are less likely to injure the horses and are less inconvenient to traffic than other falls. Falls on haunches are more numerous on asphalt than on wood. Complete falls are fewest on wood and most on granite. The falls on asphalt are generally due to sudden pulling up and short turning; those on granite,

to excessive width of the blocks, which fail to afford proper foothold.

MAKES DIFFERENCE IN DURABILITY.

On page 10 the author discusses the durability of the pavement and says:

> The durability of the pavement is its quality which relates to the length of time during which it is serviceable, and not the length of time it has been down. The only measure of the durability of a pavement is the amount of traffic tonnage it will bear before it becomes so worn that the cost of replacing it is less than the expense incurred by its use.

LENGTH OF PAVEMENT LIFE.

On page 11 he says:

The life or durability of the different pavements under like conditions of traffic and maintenance may be taken as follows:

Granite Blocks	12 to 30 years
Sandstone	6 to 12 years
Asphalt	10 to 14 years
Wood	3 to 7 years
Limestone	1 to 3 years
Brick	5 to 12 years

With reference to this table it may be stated that no reference is made to Belgian blocks. They should be properly classified, in our judgment, with granite blocks. No reference is made to asphaltic concrete, which, in our judgment, should occupy a position between Belgian blocks and asphalt, possessing a higher degree of merit than asphalt.

In the reference to the classification of wood the author fails to state whether the wood has been preserved by creosote or otherwise. We are inclined to the opinion that, if wood blocks are properly treated with a preservative, they would take a higher classification than that given in the table. The author also further fails to state whether the paving bricks were vitrified. We are inclined to the oppinion that vitrified bricks should take a better classification than given by the author.

WHY COST VARIES.

Continuing on page 13, the author says:

> The cost of construction is largely controlled by the locality of the place, its proximity to the particular material used and character of the foundation.

On page 14 he says:

> The first cost of pavement is like any other permanent investment, measurable for purposes of comparison by the amount of annual interest on the sum expended.

DISPELS POPULAR ERROR.

> *Maintenance.* Under this head must be included all outlays for repairs and renewals which are made from time to time when the pavement is new and at its best to a time subsequent, when by any treatment it is again put in equally good condition.

The prevailing opinion that no pavement is a good one unless, when once laid, it will take care of itself is erroneous; there is no such pavement.

ATTENTION! SAYS COMMITTEE.

At this point your committee wants to, with great emphasis, call attention to the above statement. Your committee is of the opinion that the greatest problem in permanent road construction is the wearing surface. Your committee is of the opinion that the wearing surface of any road has a comparatively short life. This being so, your committee regards the real vital problem in road construction as the maintenance problem. As verification of this point, your committee will continue the quotation of Bryne. He says:

MAINTENANCE THE VITAL PROBLEM.

All pavements are being constantly worn by traffic and the action of the atmosphere, and if any defects which appear are not quickly repaired they soon become unsatisfactory and are destroyed. To keep them in repair incessant attention is necessary and is consistent with economy. Yet claims are made that particular pavements cost little or nothing for repairs, simply because repairs are not made, while anyone can see the need of them.

Bryne gives a table showing the comparative cost of various pavements in Liverpool, including interest on first cost, sinking fund, maintenance and cleaning, when reduced to a uniform traffic of 100,000 tons per annum for each yard in width of the carriage way. It follows at top of next page:

SHOWS COST PER YEAR FOR LAST FIFTY YEARS.

Bryne's Table Includes Interest, Repairs, Maintenance, Replacement and All Other Expense, Based on Experience of Half a Century in United States.

	Granite Blocks	Asphalt	Wood	Brick
Foundation	$ 1.00	$ 1.00	$ 1.00	$ 1.00
Material, labor, etc.	3.25	2.50	1.40	1.80
Total first cost	$ 4.25	$ 3.50	$ 2.40	$ 2.80
Interest on material, and sinking fund, 50 years, 4%	26.00	20.00	11.20	14.40
Interest on foundation	2.00	2.00	2.00	2.00
Maintenance 50 years	2.50	4.50	7.50	2.50
Cleaning 50 years	5.00	1.00	6.00	2.50
Three renewals of surface at $3.25	9.75	....	....	....

	Granite Blocks	Asphalt	Wood	Brick
Five renewals at $2.50	....	12.50	....	....
Twelve renewals at $1.40	....	....	16.80	....
Eight renewals at $1.80	....	....	....	14.40
Consequential damages	10.00	1.00	1.50	2.00
Cost of service estimated	30.00	10.00	20.00	15.00
Total	$89.50	$54.50	$67.40	$55.60
Less value of foundation	1.00	1.00	1.00	1.00
	$88.50	$53.50	$66.40	$54.60
Less value of old material	1.00	.10	.00	.25
	$87.50	$53.40	$66.40	$54.35

Which, divided by 50, that being the life of the pavement in years, gives the annual gross cost per square yard per annum as follows:

Granite blocks	$1.75
Asphalt	1.068
Wood	1.33
Brick	1.087

	Per sq. yd. per annum
Block pavements of hard granite	23c
Block pavements of soft granite	28c
Bituminous concrete	35¢
Wood pavement	53c
Macadam on pitch foundation	71c

When the traffic is taken at 40,000 tons per annum for each yard, the showing is as follows:

Bituminous concrete	27c
Wood	41c
Macadam	47c

Asphalt is not given in this table, neither are Belgian blocks or vitrified brick, and it is not stated whether the wood was treated with a preservative.

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Bryne places asphalt between wood and bituminous concrete, making it better than wood but inferior to bituminous concrete.

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On page 209 is Bryne's table showing the approximate comparative gross cost of various pavements in the United States for a period of 50 years, the pavement at the end of that period to be in as good condition as when first laid, cost being per square yard.

CLASSIFIES "ASPHALTIC CONCRETE."

It will be noted that in this table asphaltic concrete is not given. Neither are Belgian blocks. In the opinion of your committee asphaltic concrete should take as good, or better, a classification as does sheet asphalt, and Belgian blocks will take the classification of granite blocks. The table fails to state whether the bricks are vitrified. If they are, they should take a classification more nearly approaching granite blocks. The table fails to state whether the wood has been subjected to preservatives.

TREATED WOOD BLOCKS.

We think that treated wood blocks should take a better classification that than which appears in the table. It will be noted that the items of consequential damages and cost of service are particularly severe on granite blocks and brick and are comparatively light on asphalt and wood. These items are of an intangible nature and any items of expenditure arising under them are more properly chargeable to the users of a highway than to a county laying a system of permanent roads.

CHARGE TO USERS, NOT COUNTY.

They are elements which your committee thinks in considering the sole question of ultimate cost to the county in laying a pavement should be eliminated and their elimination would materially alter the classification given to each pavement. The table is of value and interest, however, and all elements entering into the life of the pavement are to be taken into consideration. In conclusion, the rank

of pavements as to all of the elements above discussed may be classified as follows:

Durability.

1st ..... Granite
2d ..... Vitrified brick
3d ..... Asphaltic concrete
4th ..... Asphalt and wood

Serviceability.

1st ..... Asphaltic concrete
2d ..... Asphalt
3d ..... Wood
4th ..... Vitrified brick
5th ..... Granite blocks

Hygienic Fitness.

1st ..... Asphalt
2d ..... Asphaltic concrete
3d ..... Brick
4th ..... Granite blocks
5th ..... Wood

Service on Grades.

1st ..... Granite or Belgian block
2d ..... Brick
3d ..... Wood
4th ..... Asphaltic concrete
5th ..... Asphalt

Gross Annual Cost.

1st ..... Asphaltic concrete
2d ..... Asphalt
3d ..... Brick
4th ..... Wood
5th ..... Granite and Belgian block

However, as before explained, brick and Belgian block if all intangible elements are eliminated should take a better classification.

Facility for Cleansing.

1st ..... Asphalt
2d ..... Asphaltic concrete
3d ..... Brick
4th ..... Granite or Belgian block
5th ..... Wood

In the opinion of your committee this is not so important on a country road as on a city street.

AGENCIES OF DESTRUCTION.

Under this head, on page 24, Bryne says:

> The agencies causing destruction of paving materials may be classified as mechanical, chemical and physical and organic. It is estimated that the mechanical agencies cause 80 per cent of the destruction and the others 20 per cent. The mechanical and physical agencies exert the greatest action on the surface, while the chemical affects both the surface and the substratal portions.
>
> The mechanical agencies due to traffic are *(a)* Impact produced by the action of horses feet. *(b)* The precussive and abrading action of moving wheels. *(c)* The crushing due to the weight of the load on the wheels.
>
> The mechanical agencies are generally applied in their most destructive forms, namely, in the presence of water, this producing abtrition in the presence of a solvent, in which condition their destroying effect is most energetic.

The chemical agencies are water and the various acids present in the atmosphere, and the humus acids derived from the decomposition of animal and vegetable matter. The action of the chemical agencies is very slow, and their effect may be ignored except in the case of rock already in a state of decomposition or containing readily soluble mineral matter. The rocks that are most susceptible to the solvent action of water impregnated with acids are the limestone, calcareous sandstone and granite containing feldspar.

The physical agencies are:

(a) Air in the form of wind.

(b) Heat due to changes of atmosphere, and

(c) Ice.

Air acts mechanically to remove the loose material and transport it in the form of dust. Heat, through changes of atmosphere, causes expansions and contractions which produce a slight movement among the component particles of material, thus breaking their cohesion and leaving them more susceptible to the destroying effect of the other agents. Ice water penetrates into all the materials employed for paving purposes, and at the freezing temperature it acts mechanically to disrupt the material by the pressure exerted while passing from the liquid to the solid state.

Organic agencies. The organic agencies are vegetable or fungus growths that thrive in damp shady places.

Continuing on page 26, he says:

> The properties which the material used for paving must possess in order to resist the destroying agencies are physical and chemical. The physical properties comprise resistance to crushing, impact and abrasion. The chemical properties consists of the ability to resist, for a considerable length of time, the disintegrating action of the several physical, chemical and organic agencies due to weather and present on the surface of the roadway. This quality is generally designated by the term durability.
>
> The ability to resist crushing varies with the character of material and frequently varies to a considerable extent in the same material. In the plastic or viscous materials it depends upon the strength of the cementing medium or adhesive power of the matrix; in stones, brick, etc., it depends upon the cohesion and interlocking of the component particles.
>
> Since the resistance to crushing possessed by all the material commonly regarded as suitable for paving is in excess of that actually required in use, this property is of secondary importance in determining the enduring quality of material, especially when it is to be placed upon a good foundation. With a weak foundation high resistance to crushing and cross breaking is essential.
>
> Resistance to impact and abrasion. This property depends upon hardness and toughness of the material. These two properties, while

closely related, are not always coincident; some materials, although extremely hard are yet so brittle that they crush easily under pressure. Materials possessing extreme hardness polish readily under friction and produce a slippery and dangerous road surface.

Hardness is generally defined as that property of a solid which renders it difficult to replace its parts among themselves. When applied to the materials used for paving it signifies the resistance offered by the material to wear by abrasion under the action of wheels.

Toughness, as applied to paving material, may be defined as that property which enables it to resist fracture under the blows produced by traffic.

Durability depends upon the hardness, toughness and chemical stability of the material. Physical defects and abrasion generally cause the destruction of the material long before it is injured by chemical changes.

DEDUCTS IMPORTANT CONCLUSIONS.

From the above the following conclusions may be deducted:

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That any pavement that is weak in resisting mechanical and physical destruction is not a desirable pavement.

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Any pavement that is durable against destructive agencies which are mechanical and physical but is weak in its resistance to chemical agencies is the

most desirable pavement, provided that its chemical resistance exceeds in life the period of time that the best pavement, showing failure from mechanical and physical causes, possesses.

CHEMICAL ACTION MAIN TROUBLE.

As a general rule it may be stated that any pavement which is protected against mechanical destruction must be one which depends for its resistance to mechanical destruction upon chemical affinity. This chemical affinity employed to resist mechanical destruction generally takes the form of a cement principle and is often in those pavements having a sheet surface.

ADVANTAGE OF SHEET SURFACE.

The advantage of the sheet surface, as long as it maintains its chemical vitality, is that traffic is borne upon its surface in the form of compression rather than in the form of tension or shear.

However, sheet pavements must be distinguished in their resistance to tension and shear, with reference to the manner in which the blows and shocks of traffic are received by the sheet pavement.

With reference to this principle, sheet pavements are of two kinds:

(1) Those that resist blows and shocks of traffic under the principle of resiliency, and,

(2) Those which receive the same under the principle of rigidity.

In those receiving shocks by resiliency there is very little abrasion, while those that receive them rigidly are subject to abrasions. The principle of resiliency is found in sheet asphalt pavements and

in asphaltic concrete. The principle has been likened to successive poundings or blows upon lead; subjected to such force the lead shows but slight abrasion, but it thins out.

This is not the entire principal of the sheet asphalt or the asphaltic concrete pavements, however, inasmuch as after blows lead retains the new position that it assumed under the blows, while sheet asphalt and asphaltic concrete pavements conform to the principle of elasticity, and after cessation of traffic blows, develop the character to return to their former position.

LIKE BREAD DOUGH.

The kneading of bread dough is a fair illustration of the principle.

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But when shear of traffic destruction is considered, all sheet pavements, if they maintain the consistency that they assume at the time of completion, effectively resist the shear force, and it is only when under either physical force or chemical disintegration they lose their sheet-like surface, that they rapidly break down under the destruction of traffic.

DEFINES BLOCK PAVEMENTS.

Pavements that do not possess a sheet surface may be designated as block pavements.

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These are found in granite or stone blocks, brick, wood, concrete blocks and asphaltum molded or compressed blocks. The use of block pavements results in either one or two things. There will

either be two materials presented to surface wear, or if traffic is borne upon the block surface entirely there must be crevices between the various blocks.

Either one of these surfaces resulting in the employment of auxiliary material is due to the interlocking principle of the block pavement.

Block pavements, being composed of small units, require a grouting principle to maintain their position under traffic conditions. If the grout is brought flush with the surface of the block, two materials come in contact with traffic—the surface of the block and the surface of the grouting material. The result of this is, especially with reference to stone blocks and brick, that both the face of the block and the face of the grouting material is subjected to mechanical and physical destruction.

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Ordinarily the block is both hard and tough; that is, it is highly resistant to chemical disintegration, while if the grouting material is of a pitch, tar or bituminous nature, it is apt to be subject to chemical disintegration. If the grouting material is cement it results in the employment of a material that is rigid.

In stone block pavements the blocks are apt to become smooth, which is the result of abrasion, and the grouting material is apt to disintegrate chemically.

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The pavement, or any pavement in fact, is no stronger than its weakest part.

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If the block surface becomes smooth it becomes an undesirable pavement. If the grouting material disintegrates it becomes displaced and the block has a tendency to shift under traffic conditions. If the cementing principle is not brought flush with the top of the surface of the pavement, the corners of the block pavement are exposed to shear and tension. The result is that there is danger of chipping under these forces.

THEY LIVE LONG.

However, the history of stone block pavements and vitrified brick pavements is that they present a long life of durability. They are admirably suited for grades upon roads. In regard to block pavement the tendency of modern practice seems to be to make the blocks of smaller dimensions than formerly and to grout with tar or asphaltum in preference to concrete or cement. The principal objection to stone block pavements and vitrified brick pavements is their original cost. However, where grade conditions and heavy traffic conditions are of paramount importance their employment is of the highest necessity and the increase in cost justified.

WOOD FAVORED BACK EAST.

In regard to the wood block pavement as laid in Europe and in eastern cities of the United States, it has developed remarkable durability as to wear under heavy traffic conditions. Its principle fault lies in its tendency to swell and rot. Both of these

tendencies have been controlled by the use of preservative forced into the wood under pressure, principally creosote or carbolineum.

NEVER TESTED FAIRLY HERE.

Wood block pavements, in the opinion of your committee, have never been given a fair test in Portland.

However, there are samples of wood block pavements which have given splendid service in the city of Portland. There is a wood block pavement on Yamhill Street which was accepted by the city on the 23d day of August, 1903, and is still in fair condition. The wood pavement on the south portion of Fourth Street was laid in 1903 and taken up, as we recall, in the fall of 1913. It was subject to some swelling, but gave excellent results.

WHY FAILED IN PORTLAND.

In our opinion the wood blocks that have been laid in Portland have failed principally for the following reasons:

1st. They were laid upon a cushion of sand which is not good practice;

2d. The wood blocks were not properly selected as to the closeness of their grain and defects existing in the material;

3d. Expansion joints were absolutely disregarded;

4th. Sufficient attention was not given to the entire removal of sap;

5th. They were not properly impregnated with the preserving materials.

Wood blocks have given excellent service in Europe. The type of wood principally employed in Europe has been gumwood and Baltic fir, while the principal kind of wood used in the United States has been long leaf yellow pine, tamarack and gumwood. The pavements in the city of Portland have been composed, as we understand it, of Douglas fir.

FIR COMPARES FAVORABLY.

From the behavement of the Fourth Street and Yamhill Street pavement we think that Douglas fir compares favorably with any material that has been employed in the wood block pavement. The authorities seem to be pretty well agreed that soft woods are more preferable in the block pavement than are hard woods.

COSTS MORE AT FIRST.

It has been found, however, that a good wood block pavement, laid under careful supervision and correct specifications, is a pavement more expensive in first cost than pavements having the sheet-like principle. Our recommendation on wood block pavements is reserved for later discussion in this report.

CONCRETE CHEAPEST AT FIRST.

We now pass to the construction of the sheet pavements. Of these pavements the cheapest in first cost is the concrete pavement. This pavement is laid in what is known as 1 course or 2 course, and it ranges in price from about $1.00 per square yard to $1.37, unless a reinforcing principle is employed, when the cost is so materially increased as to place

it in the same category with other sheet pavements, and if the thickness of the material is increased in addition to the reinforcing principle, the cost approaches some of the cheaper grades of other block paving.

GETS FULL FORCE OF SHOCK.

As has been said heretofore in this report, a concrete pavement is a rigid pavement. It therefore, receives the full force of traffic shock. It is particularly susceptible to physical forces. This susceptibility is caused by its tendency to expand and contract, principally to contract. The result is that at an early period of its life it develops cracks. These cracks are not considered, by the authorities, as a vital defect in a concrete pavement. It does necessitate, however, an immediate repair of the crack, and if not repaired in a short time, the pavement having departed from its sheet principle and presenting an edge, develops a weak point which at once becomes subjected to the tension and shear of traffic. The result is concrete being weak in its resistance to these forces, the cohesion of the mass is broken down and the pavement begins to ravel.

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It is generally conceded that the cracking of a concrete pavement cannot be entirely eliminated. It can, however, be controlled.

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It is generally controlled by the introduction of expansion joints. It has been found that if a concrete pavement be constructed without expansion joints and subjected to the cycle of weather condi-

tions, that the cracking manifests itself under a fairly accurate rule of ascertainment.

USE EXPANSION JOINTS.

It is found that this pavement will crack transversely at distances varying from 25 to 30 feet. This has resulted in the introduction of expansion joints at from 25 to 30 feet. However, the introduction of an expansion joint must, of necessity, result in the employment of two different materials at the place where the expansion joint is introduced. These two materials are the concrete material forming the surface of the pavement and the material composing the expansion joint itself.

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If the material composing the expansion joint is destroyed either as the result of chemical disintegration or as the result of mechanical or physical destruction it no longer serves its purpose, and the concrete pavement at that point immediately becomes subjected to the primary destructive forces to which the concrete pavement itself is subject.

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These, to repeat, are principally shear and tension.

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The authorities seem to differ as to whether these expansion joints should be right angle joints or oblique. The theory of the oblique expansion joint is that the shear and tension is distributed over the joint at a different angle than over the right angle, thus reducing the destructive force.

RUTS AND PIT HOLES.

The other disintegrating weakness of the concrete pavement is its tendency to abrasion, owing to its being a rigid mass. This tendency manifests itself in ruts and pit holes which ultimately expose the surface to unevenness, breaking down under tension and shear.

The principal remedy for this defect in concrete is to cushion the surface. This is done either by spreading over the surface a preparation of tar, scattering over this stone chips, which is known as the Dolarway process, or by putting over a sheet surface more or less in the nature of an asphalt sheet surface.

CUSHION THE SURFACE.

The objection to the Dolarway process is that it seems to lack adhesion; that is, it has a tendency to flake off under traffic. The result is that it must be frequently renewed. This increases the cost of maintenance of the pavement.

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Neither is the cost of maintenance limited to the cost of respreading. This is so because the flaking of the surface is not uniform; so that, in order to prevent frequent resurfacing by Dolarway, owing to the flaking of old surface which has not developed failure at the time of patching, it is necessary to remove the old Dolarway coating by a solvent, so that the cost of maintenance must include both the old Dolarway removal and the new spreading.

JUST LIKE A FOUNDATION.

If the other surface is employed it can be readily

seen that the original concrete pavement in fact becomes a base, and there is a new surface possessing all of the characteristics of the sheet asphalt pavement. In order to prevent the creeping of such a surface it would probably require a bituminous binder to get proper adhesion.

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The result would be that the original concrete pavement would be converted into a sheet pavement of asphalt, involving all the failures and elements of repair and all the defects that an original asphalt pavement would possess, and quite closely approaching in cost the cost of an original asphalt pavement.

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These remarks are not to be construed as applying to the patented pavement known as the Hassam pavement, which will receive consideration later in this report.

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It might be well at this place to discuss some of the authorities with reference to concrete pavements. It has been earnestly urged at the hearings before us that a great deal of the failure of concrete pavements has been due to faulty specifications, dirty material, particularly sand and rock, and lax inspection, and this is undoubtedly true.

CAUSES OF FAILURE.

Your committee, however, is of the opinion that a great deal of the failure, or at least premature failure, is also due to the above causes.

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In the book known as "Highway Engineers' Handbook," Messrs. Harger & Bonney being the authors, the book being dated April, 1912, on page 81 is said:

> Solid concrete pavements have been tried, the best being the Hassam pavement which is sometimes especially reinforced to prevent cracks resulting from temperature or heaving. It is understood, however, that both transverse and longitudinal cracks have developed in this type of construction. This seems to be an inherent defect in all rigid types of construction for county roads.
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> Where the traffic comes directly on the concrete surface it often wears unevenly, failing in spots. This defect has led to the application of a thin wearing coat of bituminous material and stone screenings. How successful this will prove is still to be demonstrated.

On page 71 they say:

> The selection of the most economical top course that is suitable for a given road is the hardest problem of highway engineering. The relative economy of different constructions is theoretically expressed by the sum of the first cost and the capitalized cost of maintenance and renewal. The first can be readily estimated, but the cost of maintenance and renewal cannot be figured with any degree of accuracy for single special cases, and even on large systems it can only be approximated because of the new

factor of motor vehicle traffic. The life of any surfacing is comparatively short, a fact generally overlooked in most of the popular literature on Good Roads.

On any road the amount and class of traffic will fluctuate, and roads that are designated for light traffic will often fail under temporary heavy traffic which, for some reason, is diverted from its normal course. The first improved roads built in any locality will, for a time, carry more than their share of the traffic which is naturally reduced by the subsequent construction of adjacent improvements. It can readily be seen that it is difficult to judge the amount of traffic a road will handle, and that a short time traffic estimate is valueless as a basis for a definite conclusion. The design of the top course is usually based upon a comparison of the actions of the different kinds of previously improved roads that serve districts similar to that under consideration.

CEMENT EXPERIENCE TOO RECENT.

In the text book on "Roads and Pavements" by Frederic P. Spaulding, Professor of Civil Engineering, University of Missouri, and member of American Society of Civil Engineers, fourth edition, dated June, 1912, it is stated:

> The use of Portland cement as material for surface of sheet pavement has been in use in a small way since about 1895. Until 1909, however, these pavements were very few in number, and regarded as rather doubtful experi-

ments. Since 1900 there has been a considerable increase in the use of this material, and quite a number of cities have tried it to some extent.

Most of the work that has been done is of too recent date to show final results, or determine the best methods of construction. In several instances the earlier pavements have given good wear under moderate traffic, but more experience is necessary to determine the extent to which these materials may meet the requirements of more general use, and to formulate methods of construction to secure the best results.

The objects in most instances of engineers who have constructed pavements of this kind have been to secure pavements for moderate or light traffic at less cost than brick, or other satisfactory pavements, could be constructed. Several methods of construction have been patented and many, if not most, of the concrete pavements now in use have been constructed under some of these patents. These refer both to the composition of cement mortar or concrete employed for surfacing the pavement and to the method of construction.

Three types of construction have been used for pavements of this class—

(a) Mortar surfaced pavements, in which a surfacing of mortar is applied to an ordinary concrete foundation before the concrete has set,

in order that adhesion may develop between the mortar and concrete in setting;

(b) Monolithic concrete pavements, which consist of a single layer of concrete of the full thickness of the pavement;

(c) Grouted concrete pavements, constructed by first placing the coarse aggregate to the required thickness and then pouring a grout of cement mortar over the surface so as to fill the voids in the aggregate, which is rolled to a firm surface, either before or after the grout is applied.

Concrete pavements seem to give promise of considerable development in the immediate future, and it is probable that their use will rapidly extend.

In the Fourth Report of the Illinois Highway Commission, dated the 1st day of June, 1913, and covering the years 1910, 1911 and 1912, on page 82 it is said:

Concrete pavements present many characteristics totally unlike other forms of pavement in much more general use. A concrete pavement has a rigid monolithic surface and is properly to be classified a sheet pavement. Practically all forms of rigid surface pavements are of the block type, while other sheet pavements are somewhat resilient. The fact that concrete pavements are composed of large monolithic slabs, of rather brittle nature, having a coefficient of expansion due to temperature, differing not greatly from that of steel,

makes it necessary to consider certain features of construction not usually important in other forms of pavement.

The fact that a concrete road is rigid results in the surface layer becoming subjected to far greater impact stresses than is received by a pavement of a more resilient type.

The strength of concrete to resist stresses of all character depends upon the strength of the matrix or mortar holding the aggregate together, assuming that we have an aggregate of sound hard particles. The concrete being made of various sized particles held together by the matrix, it becomes necessary that none of these particles is loosened under the action of traffic.

IMPOSSIBLE TO PREVENT CRACKING.

Owing to the constant movement of a concrete pavement due to temperature changes, it is impossible to prevent cracks forming. On hot days the pavement tends to lengthen and on cold days to shorten. It is evident that the cracks form when the pavement tends to shorten.

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If the formation of cracks in a haphazard way is to be prevented, it will be necessary to provide joints close enough together that there will be sufficient strength in the concrete to drag one-half its length between joints. . . .

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The advantage of making the cracks beforehand is that their edges may be properly protected from traffic. It will be realized at the outset that the expansion joints constitute the weak points in the pavement and that there should be as few of them as possible.

INFLUENCE OF TEMPERATURE.

If a concrete pavement is laid without expansion joints, it might pass the first season without any serious consequences from buckling, as the cracks that are formed by the low temperature might not become sufficiently filled with incompressible material but that they afforded some relief as the pavement expanded under subsequent temperature rise. But as time goes on the cracks will become more and more filled with grit, become more nearly incompressible, so that in no very long time they will cease to be expansive and afford no opportunity for movement of the pavement, which movement must be taken up by deforming the concrete and the stresses that will be induced by such deformations are beyond what is to be expected a thin slab can withstand without buckling.

On page 87 of the same report it is said:

Like all other forms of road construction, if a concrete road is to give proper service it must have proper maintenance. Just what will be necessary to do to maintain properly a concrete road cannot be entirely foreseen owing to the

limited experience of this form of construction.

CEMENT REQUIRES MAINTENANCE.

Most uneven places in concrete roads are started by the formation of a crack, the edges of which will become broken down under traffic. That a crack forms shows that there has been movement of the concrete, and doubtless the cause resulting in the cracks still exists. If the cracks should become filled with incompressible material either by pouring in a thin grout or gradually filled with dust or grit from the road, there is every likelihood that the crack will expand under subsequent movement of the concrete slab.

It is believed that it is important to leave the concrete surface free to move, as it shows by the appearance of the cracks that it is necessary for it to do so. Therefore, as soon as cracks are formed, and a sharp lookout should be kept for them, they should be cleaned out as thoroughly as possible, and filled immediately with some plastic material, such as asphaltum pitch. This will prevent the water seeping through the cracks and also offer considerable protection to the edges, especially if the crevice is flushed with a slight excess of the pitch.

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In the University of Oregon Bulletin of January, 1913, in an article entitled "Concrete Roads vs. Macadam" by Prof. E. H. McAlister, Dean of the

School of Engineering of the University of Oregon, on page 5 it says:

WILL BE STANDARD HIGHWAY.

Considering its many merits, and the fact that in the long run it is relatively inexpensive, it seems probable that the concrete road, either with or without a bituminous wearing surface, will become the standard highway of the future.

IS MOST PROMISING MATERIAL.

On page 13 he says:

The writer favors a concrete base with a thin bituminous wearing surface, as adopted in New York and California.

On page 16 he says:

Standard types of city pavements, such as bitulithic or vitrified brick, are too expensive for the great majority of country roads, and concrete is the most promising material in sight that embodies at once a moderate first cost and reasonable maintenance charge.

In the Fifth Biennial Report, covering the period from 1912 to October 1st, 1914, of the State Highway Commission of the State of Washington, on page 128, in discussing the roads of Pierce County, Washington, it is said:

EXPERIENCE IN PIERCE COUNTY.

This county is the first in the state to undertake a large mileage of concrete pavements. In 1912 the construction of 8 miles of granitoid pavement was commenced in the Puyallup Val-

ley. This pavement has given excellent satisfaction, but the cost was excessive.

In 1913 the county commenced the construction of one-course concrete pavements, using 1:2:4 mixture. One contract of this kind of pavement was a failure on account of poor aggregate and lax inspection. This section has been used as a base for a standard sheet asphalt top.

Another contract gave a pavement which has been giving very good satisfaction up to date. Owing to the difficulty of controlling quality of aggregate the county installed a large gravel and sand pit near Lakeview, and undertook to furnish crushed and washed gravel and clean sand for all its contracts as well as its own work. . . .

The 1914 specifications for one-course pavements changed the proportions of aggregate and cement to 1:2:3½, and undertook a very rigid system of inspection and control of all features of the concrete work. The 1914 work is particularly noticeable for the careful attention given to special details, such as treatment of curves, shoulders, drains, expansion joints, etc.

LONG TIME TO SET.

With reference to concrete pavements, the time of construction becomes an important element, particularly considering the comparatively short season for favorable road construction in Western Oregon. It is pretty generally admitted that in all

types of concrete construction, with the exception of the Hassam pavement, that the concrete must be kept carefully dampened for a period of 7 or 8 days, and a period of 30 days should elapse before the pavement has sufficiently set to allow traffic upon it.

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This, of course, from the standpoint of interrupted traffic, is a considerable objection.

DATA IS LACKING.

As will be noted from the discussion of the authorities, there is very little data on the cost of maintenance of concrete roads. During the hearings of your committee it has been asserted that the cost of maintenance of a concrete road is so slight that it is not to be taken into consideration. Your committee, however, is not convinced of the soundness of this assertion.

HERE IS BEST DISCUSSION.

The best discussion of concrete country roads that has come to the attention of the committee is that by Mr. Paul E. Green, a member of the American Society of Civil Engineers, in a report he made to the authorities and taxpayers of Highland Park, Illinois. Mr. Green was commissioned by the taxpayers of that village, which is a suburb of the city of Chicago, Illinois, to make an inspection of the concrete road system as it then existed in Wayne County, Michigan. Mr. Green made his inspection in June, 1913.

He was employed for the reason that the authorities of Highland Park were desirous of im-

proving their thorofares, and wanted to ascertain the merits and faults of concrete road construction. On the general subject Mr. Green says:

DOUBTS UTILITY OF CONCRETE.

—The large proportion of failures observed by the writer has caused him to seriously doubt the utility of this product as a wearing surface, in cities especially.

While cracking will not be a serious defect as far as concerns the appearance on country roads, the writer has always believed that in city streets, where the value of abutting property is largely dependent upon the character of the street pavement, and is so recognized by the laws of practically all states, the tendency of concrete to crack and spawl is a serious objection to its use.

It has been maintained, however, by the advocates of concrete pavements, that much, if not all this cracking has been caused by improper specifications and that it can be eliminated by careful construction and also by proper reinforcement with steel. It is believed that this assertion is at least partially correct and that while such reinforcement will not eliminate this tendency entirely, it will reduce it largely. The steel reinforcement will, however, if used in the proper quantities and correctly and carefully placed, add a very appreciable item to the cost of construction.

Another weak point in the lasting qualities of concrete as a wearing surface, is the fact,

about which there can be little dispute, that it is deficient in its ability to withstand abrasive action. As long as the surface is smooth and perfect, the destructive effect of traffic is small, but if any break occurs, the ravelling action of iron-shod horses and iron-tired vehicles is very apparent and the action rapidly disintegrates the concrete, the surface soon becoming rutty and full of holes. This result is to be expected from the character of the material, since concrete will withstand a very considerable compression, but a very inconsiderable shear or tension. In reinforced concrete the allowable working stress for tension is rarely over one hundred (100) pounds per square inch; and for shear eighty (80) pounds per square inch; and for reinforced work these figures are reduced. Thus, when a hole is started in a concrete surface, it is exposed at its weakest points.

COMPARES PROS AND CONS.

Mr. Green gives the advantages and disadvantages of concrete pavements as follows:

Advantages.

1. Cheap first cost.
2. Dustless and sanitary.
3. Good appearance if no cracks appear.
4. Easily cleaned.

Disadvantages.

1. Liability of cracking.
2. Inability to withstand abrasive action.
3. Bad appearance after cracking.
4. If covered with bitumen, high maintenance charges.

He also gives his opinion that the proper location for such a pavement is:

First: Streets of light traffic (less than 100 vehicles per day).

O. K. FOR LIGHT TRAFFIC.

With reference to this he says:

It is quite possible that this figure is too low, but the writer is inclined not to change the figure, it being understood that the one hundred vehicles per day refers to iron-tired, horse-drawn vehicles.

WILL DO FOR SOME ROADS.

Continuing, he says:

Another proper location for such a road was stated to be country roads where the value of the property will not be affected by cracking, and on which two hundred and fifty vehicles per day would be considered a heavy traffic.

He gives a summary as follows:

Practically all cases of concrete pavements on city streets observed by the writer in the last five years have cracked badly before they are two years old. In most cases they are also badly worn.

The same statement is true of Windsor, Ontario.

Of the Wayne County roads observed, 32 per cent of the individual slabs of the 1909 work, 27 per cent of the 1910 work, 14 per cent of the 1911 work and 21 per cent of the

1912 work is cracking and showing signs of wear.

ARE WEARING BADLY.

All streets and roads observed which have a considerable commercial traffic, and which are more than one year old, are wearing badly; as, for example, Gratiot, River and Mack roads, in Wayne County, Michigan; Park Street, Windsor, Ontario; Ohio Street, Chicago; Green Bay road, Highland Park, Illinois, and many others.

To keep concrete roads and streets in good condition there must be constant maintenance the first year, and this maintenance will increase materially year after year. This maintenance may consist of tarring cracks and holes, or covering the entire surface with tar and sand. If the latter course is followed, the maintenance expense will amount to about 10c per square yard per year.

JOINTS ARE WEAK POINTS.

To reduce cracking and spawling to an unobjectionable minimum, it is necessary to reinforce the concrete and also to increase the number of expansion joints above those now generally used. These joints should be protected. Every joint, no matter what its character, is another point of weakness of the pavement and it is a debatable question whether it will not be well to go to the other extreme and eliminate all transverse expansion joints, use longitudinal expansion joints adjoin-

ing the curb only, let the cracks come when they will, and after their appearance—maintain them.

OTHER TYPES ARE SUPERIOR.

It is believed that a first class concrete road cannot be built for less than $1.60 to $1.75 per square yard, and at this it will be inferior to the cement grouted brick pavement, or an asphaltic concrete pavement, or bitulithic pavement or a sheet asphalt pavement, any of which can be constructed at this price, or at a slight increase over these figures.

The reason for this is because of its inability to stand abrasion.

ANALYSES MICHIGAN FIGURES.

In Mr. Green's report he comments upon the assertion as to the Wayne County roads, dealing with the cost of maintenance, the assertion being that only $200 was expended in 1911 and $100 in 1912 on the 65 miles of concrete highway in Wayne County, Michigan, from which, however, must be eliminated the 1912 construction of 40 miles, which was too recent at the time of his investigation to take into consideration the cost of its repair and maintenance.

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Mr. Green points out that the report of the Commission credits certain Dolarway treatment of concrete roads to the cost of experimental road work, when, as a matter of fact, it should have been credited to the maintenance account. He also estimates that, if the cracks as discovered by him in

the road system were properly repaired that the cost of maintenance of the system would be as follows:

Joints and cracks for 1912	$1,427.30
Joints and cracks for 1913	2,378.84
Holes	820.40
Surfacing with Dolarway 1912 and 1913	3,425.18
Total	$8,051.72

And, he says that in addition to this it would require not less than $1,000 to put back road in good condition, making a grand total for maintenance to date of $9,051.72, or about $140 per mile, if the entire mileage of 65 miles is considered; or about $226 per mile if only work constructed previous to 1912 is considered.

And he concludes this discussion in this way:

> This figure is the minimum figure possible; relates to the surface of the pavement alone, and takes no account of ditching, draining, hauling, replacing entire slabs, etc. In fact, it is the opinion of the writer, after talking to the foreman making repairs, that the actual maintenance is $5,000 more than this.

IS COSTLY TO MAINTAIN.

It thus appears that a concrete pavement, as above discussed, is an expensive pavement to maintain, and the opinion of your committee is that a concrete construction should be limited to a base and not used for the surface. It is the understanding of your committee that a concrete pavement can

be laid for an average price ranging from $1.04 to $1.10.

CANNOT USE EXISTING FOUNDATION.

There is another matter to be taken into consideration, and that is that a considerable portion of the contemplated mileage improvement is now improved with a macadam surface. If concrete were employed it would be necessary to take up this macadam surface, and if the material could be utilized in concrete construction it would have to be cleaned and broken to proper sizes.

However, this is not as much of an objection if concrete is employed as it would be to other types of pavement which would require the destruction of this macadam base. This is so because of the cheapness of the original construction of concrete. The objection to concrete is the objection to the probable cost of its maintenance, and if the pavement were to fail badly, as it often has done, the necessity of having to put in entirely new slabs, which would require at least thirty days before such repaired sections could be opened to traffic.

HASSAM IS AN EXCEPTION.

The above discussion in no way is to be taken as applying to the patent pavement known as Hassam. This pavement will now be considered. It has been employed considerably in the city of Portland for street paving.

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It is composed of broken rock of designated sizes, grouted with cement. The surface is then spread over with a cement mortar, which is broomed in by

a rough brush. The prevailing practice of the Hassam Company is not to establish expansion joints, but allow cracks to appear where they will.

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Some attempt has been made to fill cracks with tar after they appear, but the manager of the company states that this has not been particularly successful, owing to the fact that the cracks are surface cracks not extending in depth into the pavement any great distance, the result being that not much of a key is furnished for the holding of plastic material which is ordinarily employed in filling cracks in concrete pavements.

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We are informed that the cost of this pavement will range from $1.40 to $1.80 per square yard, depending upon the thickness of the pavement and local conditions.

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The oldest Hassam pavement seen in the city of Portland is that on Grand Avenue south of East Morrison Street. We are informed that this pavement has been down about six years. It shows much better behavior than any other concrete pavement which your committee has seen, and from the investigations of your committee the Hassam pavement is entitled to more consideration than any other concrete pavement that has been called to the attention of your investigators.

GOOD AND WEAK POINTS.

It does crack, however; these cracks are both transverse and longitudinal. It shows evidence in

places of both abrasion and pit holes. There is raveling, principally confined, however, to the end of the day's run. Its behavior with reference to its proximity to street car rails is the best of any pavement we have seen.

EXPENSIVE TO REPAIR.

Your committee is unable to form an opinion as to just what the ultimate life of the surface of the Hassam pavement will be. In the opinion of your committee, however, in case of the destruction under traffic of the Hassam pavement, it would be an expensive pavement to repair. The patent rights of the Hassam Company will be discussed elsewhere in this report.

RESULTS MUCH MORE SATISFACTORY.

It has been stated by the present manager of the Hassam Company in Portland that a good deal of the Hassam pavement laid in Portland before 1911 has been unsatisfactory owing to the lack of interest of contractors in the pavement itself; but that since the Hassam Company are laying the pavement much greater care has been taken and the results have been much more satisfactory. In the opinion of your committee Hassam pavements since 1911 have been laid with greater care in Portland than before that time, and the result is noticeable with reference to pavements laid before and after that time—much more favorable to those laid subsequent to 1911.

TWO ASPHALTIC CONCRETE TYPES.

The next sheet pavement which we desire to dis-

cuss is the asphaltic concrete pavement. There are two general types of this pavement—that laid by the Warren Construction Company or by others under royalty license from them, which is known as the bitulithic or Warrenite. The other is an asphaltic concrete pavement which is laid under what are known as the Topeka specifications.

WARRENITE DISCUSSED HERE.

Our attention will first be given to the Warren product. It is not necessary, at this time, to discuss the Warren patents as that is reserved for later consideration.

It may be stated that pavements laid under the Warren patent are designated as bitulithic or Warrenite. There seems to be no substantial difference between bitulithic pavement and the Warrenite pavement, although there is considerable difference of opinion as to just what type of pavement is contemplated by each of these two designations.

It has been stated to us that the bitulithic pavement is one in which the ingredients entering the mixing pot are those that are weighted on a multiple beam scale; that the Warrenite pavement is one in which the ingredients are measured instead of being weighed.

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It has also been stated that the difference is this: that the bitulithic pavement has a greater thickness than a Warrenite pavement, but the explanation as given by a member of the firm of Warren Bros. is that there is no distinction other than this—that the company always lays a bitulithic

pavement in cities and a Warrenite pavement outside of cities.

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If this distinction be taken as correct, it appears that the only difference is in designation for specific purposes, and that bitulithic and Warrenite are merely trade names.

Bitulithic pavement has been laid upon streets in the city of Portland since 1903, and your committee has found plenty of examples from which to form an estimate of the behavior of this pavement.

LAID ELEVEN YEARS.

Fifth Street, from Jefferson north with the exception of a block between Morrison and Alder was paved with Warren's bitulithic in 1903 or 1904. At the present time the street is in good condition except along the street car rails. This street has been repaired.

NATURE OF REPAIRS.

No figure as to the cost of repairs to this street have been obtainable by your committee. It is claimed by Warren Bros. that the only repairs made to this street have been those caused by the settlement of foundation areas due to excavating in the laying of water pipes and other street furniture, and the subjecting of the surface of the street to a flush coating which forms a thin bituminous cushion surface, the purpose being to seal the surface of the street to keep it waterproof.

BEST PAVEMENT IN CITY.

Others have claimed, however, that this street,

in certain places, has been subjected to a heavy asphalt cushion due to failure developing in the street. However, your committee is of the opinion that Fifth Street, considering the traffic upon it, is the best pavement in the city of Portland, and it gives every indication of having a future life of a great many years.

ABSENCE OF CRACKING.

No cracks have developed in this street that your committee has been able to find, and this absence of cracking seems to be characteristic of Warren's bitulithic pavement, and by virtue of this fact it is to be put in a class by itself when compared with other sheet surfaced streets. The advantage that it possesses in this particular is that it maintains a smooth surface taking compression and that there is no tension or shear upon its surface because it does not crack.

ONLY FOUND ONE BAD PLACE.

Your committee has only found in its inspection of many bitulithic streets in the city of Portland and its inspection of Warrenite pavement within the vicinity of Portland one spot where cracks have developed in a bitulithic pavement.

SOME FAILURES NOTED.

A number of failures of Warren's bitulithic pavement have been called to the attention of your committee. Second Street in the city of Portland has undoubtedly given the Warren people a great deal of trouble. The same is true of Grand Avenue, north of Morrison Street, and your committee has

heard of a failure developing in the city of Eugene, Oregon, as well as some of the Warrenite pavement laid on the county roads in King County, Washington.

OPINION ON FAILURES.

But, your committee is of the opinion that this percentage of failures is small when compared with the large percentage of successes that this pavement has shown under traffic conditions varying in volume and covering a period of years all the way from 8 to 11 or 12.

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In regard to the failures of the Warrenite pavement in King County, Washington, the Warrens maintain, and your committee believes it to be true, that these pavements were laid by contractors, under license royalty, and in several instances the contractors were inexperienced, while in others sufficient supervision and care were not taken either in mixing or in laying.

The failure in Eugene was probably due to a bad foundation problem as it is well known that the street in Eugene which was laid with bitulithic presented a bad foundation problem owing to the low flat nature of the street.

COMMITTEE IN DOUBT.

Second Street in Portland was laid at a time when weather conditions were bad. In regard to the Warren pavement—it has been asserted that Warrens do not always lay a pavement up to their specifications, and that in case of repairs they have used a mixture which did not contain a bitulithic aggregation. In some instances your committee is

of the opinion that possibly the first assertion might be true, although your committee is in doubt on this point.

THIN COAT FOR REPAIRS.

In regard to the second assertion, the point is undoubtedly correct, and it seems to be admitted by the Warrens that in making repairs they cannot always use their preferred aggregate, owing to the fact that the surface to be repaired is so small in area that they could not employ the aggregate and make a neat repair and, therefore, they use less-sized particles in cases of that kind.

HOW SAMPLES ARE SELECTED.

A sample was shown your committee of a piece of pavement taken from Division Street near 30th in the city of Portland, which did not have the appearance of conforming to the bitulithic aggregate. Your committee requested the Warren people to make an investigation of this pavement. They did so, and submitted an analysis and a sample of the pavement which materially differed from the original sample shown to your committee.

COMMITTEE GETS OWN SAMPLE.

In all probability each side selected a sample most favorable to its position. It became necessary for one member of the committee to obtain an independent sample, which seems to possess the characteristics of standard bitulithic.

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It is but fair to the Warren Company to state, however, that this Division Street pavement was not laid by the Warren Construction Company. It

was laid by a company having license from the Warrens to lay it.

BEHAVIOR ON LINNTON ROAD.

There has been a great deal of talk concerning the behavior of the Warrenite pavement on the Linnton Road, Multnomah County. This pavement was laid about the year 1911 or '12. It has recently been flush coated at the cost of about 2 cents per square yard. At the edges it developed some failure.

It is claimed by the Warren people, however, that the county failed to run a header along the edges of this road, with the result that when the pavement was rolled it feathered out under the compression and it was these thin edges that developed failure.

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It was also asserted by the Warrens that the Linnton Road has a bad foundation problem, and that they would not desire or care to construct any more Warrenite pavement on the Linnton Road, unless the pavement were carried on a concrete base. The Warrens advocate that a flush coating on their bitulithic pavement be applied about once every five years, that this has a tendency to keep the pavement sealed and waterproof.

EFFECT OF WATER.

At this point it might be well to explain the failure of a street having an asphalt or asphaltic concrete surface as a result of the action of water upon its sheet surface. Water, if it stands any length of time upon a street of this character, has a tendency to disintegrate the asphaltum cement.

It has a tendency to cause the pavement to become brittle due to the volatilization of certain chemicals in the asphaltum.

When this occurs the pavement shows a lifeless surface, showing particles of sand over the surface and rapidly disintegrates. From this it can be readily seen that if the asphaltum loses its power to withstand compression and shear, there will be a shoving of sand particles and the crystallized asphalt with the result that holes develop and the pavement rapidly breaks down under tension and shear. Therefore it is necessary to keep the water out of an asphaltic concrete pavement, and this flush coating process of the Warrens seems to be resorted to for that purpose.

SIDE BY SIDE.

A good illustration of a street that has been flush coated and one that has not may be seen on Jefferson Street between Fifth and Sixth, in Portland; one-half of this street has been flush coated, the other half has not. The difference is quite noticeable.

SMALL COST OF MAINTENANCE.

There is another point about the Warren pavement which merits attention. Your committee is of the opinion that it can be easily and cheaply repaired, so that with the small maintenance cost the life of the pavement will cover the minimum period of 15 years as before referred to in this report. The ease of repair seems to be principally due to the fact that where the repair must be made by the incorporating of new material, it can be done

by building the pavement up without having to go down to any subfoundation. This is so because there seems to be perfect adhesion between the new repairing material and the old material. This is not true of an asphalt sheet pavement.

REPAIRS REQUIRE FINER MIXTURE.

It, however, may be said in this connection that where repairs of this character are made that a finer-sized mixture must be used in making the repair than in laying the original pavement. In the opinion of your committee the repairs by the adhesion of new material to old and the filling of holes would not even have to be resorted to if the foundation maintained its integrity, the principal repair being the flush coating of the surface of the road.

ITS SOURCE OF STRENGTH.

Your committee is of the opinion that inherently the Warren aggregate, by virtue of the employing of graded sizes of stone from 2 inches down to a fine powder, presents a pavement which is strong in its power to resist compression, irrespective of the asphalt binder employed in the mixture.

STONE, NOT BITUMEN, CARRIES WEIGHT.

In most sheet pavements employing the asphalt principle, the resistance to compression is obtained from the inherent stability of the asphalt or bitumen after it is set, while in the Warren pavement dependence is placed upon the stone in the aggregate rather than the asphalt.

BINDER IS MORE ELASTIC.

The result is that either a less amount of asphalt

may be used, owing to the arrangement of the stone sizes resulting in the reduction of the voids, or a grade of asphalt may be employed which results in a permanent binder which is soft and more oily, thereby resisting in a greater degree the volatilization and tendency to become brittle that asphalt develops as a result of its chemical failure.

WON'T DISPLACE EVEN WHEN WARM.

It has been asserted and your committee believes it to be true, that after the mixture in the bitulithic pavement has been spread upon the surface to be paved and rolled, that motor trucks can drive over it without a displacement as a result of the compression of this traffic. This is evidence of the fact that before the asphalt binder has cooled, as it must do before it can set, that the aggregate of stone in the mixture possesses an inherent stability of its own.

BROKEN STONE AND OLD MACADAM.

We will not dwell further upon these points at this time as they will be more fully discussed under the head of the Warren patents. It may be remarked, however, that this stability presented by the Warren pavement results in the employment of a different type of foundation without violating safe practice, for in this type of pavement we think it has been demonstrated beyond successful dispute—that under ordinary conditions a foundation of broken stone may be used for bitulithic or Warrenite pavement. The result of this would be to greatly reduce the cost of the

Warrenite pavement on those portions of the county roads which require new foundations. This is true unless other standard types of pavements can be successfully laid upon a similar foundation.

It would also allow the employing of the present macadam on those roads which are now surfaced with that material, but this is not of so much importance as in all probability a sheet asphalt pavement or a pavement of the Topeka specifications could use the same base.

HERE IS TOPEKA MIX.

We come now to the construction of the Topeka specifications. As will be more fully explained in the discussion of the Warren patents, the Topeka specifications were the result of the analysis of certain asphaltic concrete pavements laid in the city of Pittsburgh, Pa., a number of years ago.

It is not contended by the Warrens that a pavement of the Topeka specifications is an infringement on their patent. These pavements have been laid in the city of Portland, but are of recent date.

Your committee examined a number of them, and is of the opinion that this pavement, as far as they could tell from the pavements they saw, should be placed in the category of sheet asphalt pavements. They have been laid in Portland for about two years.

One pavement was put down in Springfield, Oregon, in the year 1911; and also in 1911 the street known as D Street in Salem.

MUCH IN VALLEY TOWNS.

A considerable amount of this pavement has

been laid in the Willamette Valley towns of Oregon.

The pavements that your committee saw in Portland, down about two years, have developed a tendency to crack, showing both transverse and longitudinal cracks.

DEVELOPS TENDENCY TO CRACK.

This cracking is analogous to the behavior of sheet asphalt streets.

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Your committee, however, is not able to absolutely classify this pavement.

HIGH PER CENT OF VOIDS.

It does know, however, that the pavement possesses more than 21 per cent voids and that the aggregate of material in the mixture, aside from the asphalt binder, possesses no inherent stability. Still, reliable evidence as to the good behavior of this pavement under traffic has been brought to the attention of your committee. It seems to have done well in Pittsburgh, where it was first employed, although after a time it appears to have been abandoned in Pittsburgh and was not employed again until used in Topeka, Kansas.

MEETS WITH MUCH FAVOR.

It seems to meet with favor upon the part of Mr. Linn White, the engineer of the South Park Board, Chicago, Illinois. Your committee has been unable to obtain data concerning the method employed in its repair or cost of its maintenance as it has been of too recent date to absolutely establish items of cost in this particular.

AT LEAST IS EQUAL OF ASPHALT.

It is the opinion of your committee that this pavement, if carefully laid, will be at least the equal of an asphalt street and probably better than an asphalt street, particularly if it could be repaired by the obtaining of adhesion to old and new material. Your committee is of the opinion that this adhesion can be obtained, as it finds that where bitulithic pavements are repaired, due to foundation failures, that, what in effect amounts to the material of Topeka specifications has been employed in the repair and proper adhesion has been obtained.

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One or two of the earlier streets of the Topeka specifications laid in Portland employed a flush coat similar to that used on the Warren's bitulithic. The more recent constructions under the Topeka specifications have employed a cement dust surfacing instead of the flush coat. There is no unanimous opinion as to the reason for the departure from the flush coat to the cement dust surfacing. It seems to have been brought about at the instance of the city.

PATENT ON FLUSH COAT.

The Warren Bros. claim that they informed the city that the use of this flush coat on a pavement of Topeka specifications violated one of their patent rights, as they claim to have a patent on the flush coat employed. On the other hand, it seems to be maintained by others that the flush coat is composed of but tar and sand and that the only right that the Warrens have is to the trade name

on some of the asphaltic oil entering into the flush coat as an ingredient. The patent right of the Warrens as to this flush coat will be discussed later.

SHEET ASPHALT PAVEMENTS.

We now arrive at a discussion of sheet asphalt pavements. This discussion can be brief. Asphalt is not suitable for country road construction as compared with other standard types.

First, because it is high in price;

Second, because it is slippery;

Third, because its chemical life is comparatively short;

Fourth, because of the difficulty of its repair.

We know of no advocate for a sheet asphalt surface on the contemplated county road improvement. If it were to be used on roads requiring the use of new foundations, it would require either a concrete base or a bituminous base. It is doubtful if the crushed rock base could be used. It could, however, be used on the old macadam base on roads where such a base exists.

REASON FOR FAILURES.

But, the principal objection to asphalt is that, more than any other pavement in existence, it must be attuned to traffic conditions; that is to say, where traffic is light the mixture should be different than where traffic is moderate, and should not be used at all where traffic is heavy. The failures of asphalt are due to its disintegrating as above pointed out, and also due to the fact that under light traffic it is apt to crack.

CONDITION OFTEN LIFELESS.

Your committee examined sheet asphalt pavements in Portland upon which there was little or no traffic and where the pavements had been down only two or three years; these pavements presented a lifeless condition and were full of cracks, and will go to pieces in a very short time, irrespective of the volume of traffic upon them. This is due to the fact that asphalt maintains its vital principal longer under the kneading process of moderate traffic, and if it is not given this kneading process it becomes brittle and develops, under expansion and contraction, numerous cracks which, of course, are great faults in any pavement, as they are readily torn to pieces by the destruction of traffic.

DISCUSSION OF PATENTS.

So much has been said about the legality of the Warren patents that your committee feels it necessary, at the expense of some length and slight repetition, to discuss this matter. From time to time during its investigation, the assertion has been made to your committee that the Warren patent covering Bitulithic and Warrenite pavements, and the patent covering the Warren flush coat mixture were invalid and had been held so by the Courts.

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It has also been claimed that the Warrens have always sought to avoid litigation on the merits of their patent rights. That in the various suits instituted by them to protect their patents, if they saw that the evidence of their opponents was

particularly strong, the policy of the Warrens was to make a compromise by agreeing that if their opponents in the litigation would consent to a decree to the effect that the Warren patents were valid and had been infringed, the Warrens would waive all royalty under their patents.

REVIEW OF LITIGATION.

In view of these assertions and claims, your committee deems it necessary to review the litigation as far as it has been able to find the same reported in the printed reports of the various courts.

MORAL RIGHT AT STAKE.

In regard to the general subject of patents your committee is of the opinion that if a patent for a pavement is valid that no sound reason can exist why the inventor or owner of the patent should not be entitled to the fruit of his genius in the form of a royalty.

This right is guaranteed to all inventors under the laws of their country.

A sound public policy justifies patent monopoly.

The protection of a patent furnishes strong incentive for inventive genius.

PUBLIC GETS THE BENEFIT.

The general public, in countless instances, has reaped great benefit which otherwise never would have been had not inventive endeavor had for its goal the hope of monetary reward held out by the limited monopoly that the patent laws give. The ultimate public benefit under the patent laws is that the public will, after the limited time has ex-

pired protecting a patent, have the use and benefit of the invention or discovery for all time, and that too, without charge or price for the discovery or invention, after the expiration of the patent period.

DEPENDS ON VALIDITY.

On the other hand if a patent be in fact invalid, then all reasons for the protection fails and the public is under no legal or moral duty whatsoever to compensate the holder of such illegal patent in the employment of the device or process when it becomes necessary or desirable to use the same.

HISTORY OF WARREN PATENT.

The Warren patent for a bitulithic or Warrenite pavement was granted to Frederick J. Warren on May 5, 1903, and bears serial number 727,505 and was for a new and useful improvement in street pavements. The patent has been attacked on the principal ground that the Warren method for street pavement was not new, had been used before, and therefore had, under the patent laws, been anticipated. Also, that under what is known as double patenting the patent was invalid. These claims are questions of fact, any one of which, if true, would invalidate the patent. They have all been passed on by the courts, as will hereafter be shown.

NATURE OF INVENTION.

The pavement that Warren invented has for its component parts broken stone in graded percentages from stone that will pass through a 2-inch ring and be retained by 1½-inch ring down to impal-

pable powder mixed with bitumen or coal tar; subjecting the graded stone and bitumen mixed together to heat, the stone and bitumen forming a conglomerate mass which is spread hot over a foundation of either concrete, bituminous base, broken stone or old macadam.

AVOIDING VOIDS THE OBJECT.

The mixing of the properly graded stone from two inches down, having added to it a certain percentage of impalpable powder fills the spaces between the stone of larger sizes. Thus it is claimed that the density of the large solid stone will result in a given mass with a less percentage of voids than the use of small particles. That this is true appears from the following example:

HERE IS A SIMPLE ILLUSTRATION.

Let a 3-inch cube of stone be placed in a box of close fit; now let the stone be broken into small particles; these particles will more than fill the box; the surplus of particles over the filled box is the result of the voids or interstices between the particles.

RESULTS OBTAINED.

The reduction of voids in the use of graded stone in mass results in three things:

First, a combination that resists in high degree compression or static force independent of the bituminous or coal tar binder;

Second, less voids to be filled by the binder, resulting in the destructive force of traffic being borne in a greater per cent upon the stone than upon the bitumen; and

Third, inasmuch as the bitumen that must carry a high percentage of compression must be of a grade so as to become hard when set, while a grade that is used for a binder remains more plastic after setting, the hard being more susceptible to disintegration under water than the soft, the result of the Warren patent was that less bitumen was used, and the grade less subject to water disintegration, thereby resulting in a pavement more impervious to the elements to which pavements must, of necessity, be subjected.

PRODUCT, NOT PROCESS.

Warren claimed his invention was a product, not a process; that is, he admitted that before his invention broken stone, bitumen or coal tar and stone powder had been used in combination for paving. He made no claim for a patent based upon the novelty of the process, but he did claim that the process before his patent was confined to layer combination resulting in a pavement having no inherent stability and having more than 21 per cent of voids.

CASES ARE CITED.

In cases in which the Warren patent No. 727,505 has been before the courts the courts have upheld the Warren patent with the exception of one in which the Warrens dismissed their suit for infringement after the court had denied them a preliminary injunction.

In this case, after the denial of the preliminary injunction, the suit was still before the court on the merits of the Warren patent, particularly with

reference to the question of anticipation or prior use. This was a case in which the Warrens claimed the city of Chicago, through its South Park Board, and a paving contractor, were infringing patent No. 727,505. The opinion of the court was never reported in the law reports. The detail of as much of it as we have been able to obtain will appear elsewhere in this report.

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We will now consider the reported cases with reference to Patent No. 727,505 in the order in which they appear in the books.

The first is the case of Warren Bros. Co. vs. City of Owosso, decided on January 13, 1909, and reported in No. 166 Federal Reporter, page 309. This was an opinion by the United States Circuit Court of Appeals for the Sixth Circuit. In a patent case under the act of Congress of March 3, 1891, the judgment or decree of the United States Court of Appeals is final within the territorial limits of its jurisdiction and beyond its territorial limits is followed on points of law by other United States trial and intermediary appellate courts under the rule of comity.

Also by the Act of March 3, 1891, the Supreme Court of the United States may review the final judgment or decree of the United States Circuit Court of Appeals when, as questions of law they are certified to it by the United States Circuit Court of Appeals or by a writ of certiorari or otherwise issued by the Supreme Court itself. The practice of the Supreme Court, however, as we

understand it, is not to issue any such writ unless United States Circuit Courts of Appeals in the various circuits hold contrary opinions on the same points of law. The object of the writ of certiorari being to have the Supreme Court of the United States establish uniformity of law throughout the United States when two or more Circuit Courts of Appeals of the United States in different circuits have ruled differently on such points of law.

The bearing of the above on the Warren patent is this: that two circuit courts of appeals in different circuits have upheld the Warren patent, and one circuit court up to the present time has held the patent to be invalid.

STATUS IN SUPREME COURT.

The result of this is that in the absence of an adverse ruling the Supreme Court of the United States will not take jurisdiction of the validity of the patent. In fact, it appears that the United States Supreme Court has declined to issue a writ of certiorari with reference to the patent. This is not saying, however, that the refusal to issue the writ was an adjudication on the patent.

We are of the opinion that if any United States Circuit Court of Appeals held the patent invalid that the Supreme Court of the United States will take jurisdiction of the case and decide the same as it sees fit on the merits.

For all present purposes of litigation, however, the Warren patent has reached final adjudication on its merits under the rule of comity, unless it is

possible to produce new evidence on the subject of anticipation or prior use.

But to return to the Owosso case.

In this case Judge Lurton upheld the patent, holding that the evidence did not show prior use or anticipation, and, in effect holding that the patent was not invalid on account of double patenting. This is the leading case on the Warren patent No. 727,505.

This case has been criticised, it being contended that the defense to be alleged infringement was conducted by the Barber Asphalt Co., it being a party defendant with the City of Owosso; and that the Barber Co. intentionally made a weak defense.

It is also asserted that the principal evidence in the case, with reference to prior use, was an abandoned sidewalk constructed in front of the asphalt company at Long Island City, New York.

It is also maintained that the Court made a distinction between anticipation in the use of a sidewalk and a street pavement. We think, however, that the alleged weak defense theory is not borne out, nor is the assertion that the Court passed its ruling entirely on the sidewalk case.

QUOTES COURT DECISIONS.

In this we do not restrict ourselves to our own opinion in the matter, but cite the language of the United States Circuit Court of Appeals for the Second District, in the case of Warren Bros. vs. the City of New York, 187 Federal Reporter, page 831, in which case on page 835 the Court says:

It is stated that in the Owosso suit the only defense made to the patent was an assertion of its invalidity by reason of a single instance of prior use in the shape of a sidewalk laid at Long Island City.

Reference to the Owosso record, however, shows numerous prior patents and prior publications introduced and commented upon by expert witnesses, and page after page of discussion of the art generally and of the meaning of the specifications and claims of this and other patents taken out by Warren and others. The most cursory examination shows that 1,800 pages were not wholly devoted to the history and characteristics of the pavement at Long Island City, and the opinion of the Circuit Court of Appeals shows that prior patents were discussed and considered.

Nor do your committee find that the Owosso opinion was based solely upon the distinction between a sidewalk and a pavement. On page 313, (166 Federal Reporter) in the Owosso case the Court says:

> Whether a patentable invention would be involved by employment of the same construction for roadway purposes which had been publicly employed for sidewalk purposes is another question, and one which we pretermit now as not necessarily presented upon the facts of this case.

The Court then goes on to review the evidence of the sidewalk. At page 315 it says:

> The sidewalk construction was much the closest approximation to the invention of Warren.

The Court then states the sidewalk to be an experiment and at page 317 says:

> The contention that the construction of this sidewalk was not an experiment, because it was laid upon a public highway and subjected to practical public use, does not take it from the category of experiments. It was a product which could only be tested with respect to its durability for pavement purposes by laying it upon a highway. The facts, in this respect, are similar to those of Elizabeth vs. Paving Co., 97 United States, 126, where it was held that Nicholson's pavement had not been in public use within the meaning of the patent law, because an experimental section had been laid down and used by the public for some six years before he applied for a patent. The use was held, upon the facts of the case, to have been purely an experimental one.

The next case in which this patent was called in question was that of Warren Bros. vs. City of Montgomery, 172 Federal Reporter 414. In this case the Warrens claimed that the specifications for the construction of a pavement on East Jeff Davis Avenue in the city of Montgomery, Alabama, was an infringement. In defense to this claim it was contended that the Warren patent had been anticipated by certain prior pavements in the city of Washington and by double patenting. The case

was decided in favor of the Warren Company. At page 421 the Court says:

> When the defense is anticipation, it must be shown, and, if there is any reasonable doubt on that point it must be resolved against the defendant, on a motion for a preliminary injunction (cases cited). In view of these principles, and after careful consideration of the new evidence regarding the Washington pavement, which was not before the Court in the Owosso litigation, but was before the Circuit Court of Illinois; this Court holds that the defense of anticipation is not made out.
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> The substance of the other defenses, leaving out the question of infringement *vel non,* is that the patent does not disclose invention and that there have been double patents. On these points the Court is of the opinion that at this state of the proceeding it should follow the decision in Warren Bros. vs. Owosso, *supra.* While the decision does not discuss the question of double patenting, it inevitably overrules that defense.

The ruling of the Court in this case was that substantial justice would be done if defendants filed a bond in a given amount in addition to paying all costs and damages as may be awarded against defendants if, upon final hearing, it should be adjudged that the street paving in East Jeff Davis Avenue infringed any claim the complainant could lawfully set up under letters patent No. 727,505. This order of the Court reserved the right to litigate the

merits of the patent on final hearing. The final outcome of this case has not been available as far as your committee can find.

The next case was that of Warren Bros. vs. City of New York, 187 Federal Reporter 831. This was an appeal from the Circuit Court of the United States for the Southern District of New York from an order granting a preliminary injunction to the Warrens and the order of injunction was affirmed. The Circuit Court's opinion appears in the reported opinion of the United States Circuit Court of Appeals. In this litigation it was contended that the prior use of pavements in Washington, D. C., Chicago and Cincinnati were anticipations of the Warren patent. At page 833 the Circuit Court says:

> I have examined the affidavits and the specimens by both sides from Washington pavements and am confident that the testimony does not establish anticipation beyond a reasonable doubt. . . .
>
> The Cincinnati use is even more remote. The pavement there is laid in blocks and is not intended at all for vehicular traffic. The Chicago uses need not be discussed as they are no better references than those to which our attention has been called.

At page 826 the Court says:

> As to the three new alleged prior uses and the question of infringement, we are in entire accord with Judge Coxe's reasoning and conclusion.

The next case is that of the City of Grand Rapids vs. Warren Bros., 196 Federal Reporter 892. This was an appeal from an order of the Circuit Court granting Warren Bros. a preliminary injunction restraining defendant Seamans from paving a certain street in Grand Rapids under specifications that were an infringement on Warren's patent. The appeal was on a collateral issue. This case came before the District Court, Western Division, S. D. Michigan, on its merits in Warren Bros. vs. Grand Rapids, 216 Federal Reporter page 364. The question was whether certain specifications showing a mineral aggregate of less than 21 per cent of voids was an infringement of the Warren patent. At page 366 the Court says:

> The sole question here to be determined is this: Under the evidence and the ruling of the Circuit Court of Appeals of this circuit, will the wearing surface of a pavement constructed with the above specifications be an infringement of complainant's patent.

At page 367–368 the Court continues:

> For, assuming defendant's contention to be correct and viewing the evidence most favorably to them, the mineral aggregate produced by them, and which they claim will be used in the construction of the pavement, fairly falls within the claims of the patent. The tests made show conclusively that such a mineral aggregate when thoroughly mixed and properly compacted will have less than 21 per cent of voids or the required density of the patent

product. While such a mineral aggregate would not contain the inventor's preferred maximum sizes of stone, yet the evidence, which is at most but feebly contradicted, shows that it will contain the preferred proportions and the essential grades of sizes, and that it will have a useful degree of stability. Having the required elements of density and stability, the product must necessarily possess the "inherent stability" which is the broad and fundamental idea embodied in the invention and embraced in the patent. A decree will be entered enjoining the defendants from carrying out their contract for the construction of the Barclay Street pavement.

CELEBRATED TOPEKA CONTROVERSY.

There now remains the question of consent decrees in which it has been claimed that the Warrens have made agreements in litigation whereby they have waived their royalty in consideration that it be stipulated that decrees be entered upholding their patents. As near as we have been able to ascertain, the grounds for these claims seem to have originated in the litigation the Warrens had in Topeka, Kansas.

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No report of this Topeka case seems to appear in the printed law reports.

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As we gathered the facts it seems that in the case of Warren Bros. vs. the City of Topeka, the city had prepared specifications for pavements which

the Warrens sought to enjoin for infringement of their patents. On a hearing the City of Topeka defended their right on the ground that the Warren patent had been anticipated by the construction of an asphaltic concrete pavement on Lang Ave.; also Bellfield Ave. and Sherman St., in the city of Pittsburg, Pa., which pavements were constructed prior to 1898 and had been in constant use from date of construction until the present time (August, 1909) and were in good condition:

> That said asphaltic concrete pavements were composed of a mixture of crushed stone, sand and bituminous cement so proportioned and mixed as to produce enough bituminous mortar from the finer particles of stone, the sand and bituminous cement to fill all the voids or interstices of the stone and produce a solid homogeneous mass, free from voids.

These facts were supported by the affidavits of Joseph H. Ryan, superintendent of the City Asphalt Paving Plant, Wm. D. Hamilton, an employee of the Department of Public Works of Pittsburg and James Martin, a resident of Sherman St., in said city, having lived on that street for a period of about eleven years. The Warrens contended that the Pittsburg streets were not of a density having less than 21 per cent voids, which the specifications under which Topeka was seeking to lay pavements did have. They said that they did not consider the specifications of the Pittsburg streets as being an infringement of their patents—that if the Topeka

people wanted to lay pavements like the Pittsburg pavements to go ahead and do so.

TOPEKA ABANDONED ATTEMPT.

The outcome of the case seems to have been that the city of Topeka abandoned its attempt to lay pavements under the specifications upon which it was sued and laid pavements after the Pittsburg specifications which was not contested by the Warrens. This is the original, as we understand, of the now famous Topeka specifications for asphaltic concrete.

ALLEGED BREAKING OF PATENT.

The next case is that of Warren Bros. vs. City of Creston, Iowa et al. In this case it has been claimed that the Warren patent was broken. In this we are unable to concur. The material part of the decree is conclusive on the point; it is as follows:

Thereupon it was agreed that the following decree might be forthwith entered as hereinafter specified. And, it appearing to the satisfaction of the Court that the specifications for the work as constructed by the defendant City of Creston, Iowa, requires said contractors to use in the construction of the wearing surface of the pavement contracted to be built in said city of Creston, Iowa, no particles of stone that would not pass a screen with openings ½ in diameter, and that less than ten per cent of the stone or coarse sand would be retained upon a screen with openings ¼ in diameter, and all the remaining mineral matter used should be finer than ¼ in diameter.

And it further appearing that the pavement constructed by the use of mineral particles as above described would not infringe the claims of complainant's patent in this case, No. 695,421, and it further appearing that the pavement to be constructed in said city of Creston, Iowa, will be constructed in substantial compliance with the following formula, to wit:

Bitumen	from 7 to 11%
Mineral aggregate passing 200 mesh screen	from 5 to 11%
Mineral aggregate passing 40 mesh screen	from 18 to 30%
Mineral aggregate passing 10 mesh screen	from 25 to 55%
Mineral aggregate passing 4 mesh screen	from 8 to 22%
Mineral aggregate passing 2 mesh screen	less than 10%

same to be used in the order named and that the said pavement so constructed will not infringe the claims of said patent.

It is, therefore, ordered that the matters in controversy between the parties litigant having been settled in accordance with the above findings, the bill heretofore filed in this case be dismissed without costs as against either party.

Done and ordered of record this June 16th, 1910.

(Signed) SMITH McPHERSON,
Judge.

CASE ADJUSTED WITHOUT TRIAL.

We have now arrived at that point when it is

necessary to consider the South Park Board Chicago case. There can be no doubt about it—the Warrens failed to obtain a preliminary injunction for the infringement of their patent. This left the case for trial on its merits. It was never tried. The contractor not being prevented by a preliminary injunction finished his contract. An affidavit by J. M. Head, General Counsel for Warren Bros. filed in the case of Warren Bros. vs. City of New York above discussed, says of this case:

> That he has heretofore filed an affidavit in this case and that as General Counsel for Warren Bros. he was present in the City of Chicago, Illinois, and took part as counsel in the ex parte application for a preliminary injunction against the South Park Commissioners and Metropolitan Construction Company to prevent the construction of a street pavement on Michigan Boulevard in said city of Chicago, which construction, it was claimed, would infringe the patent No. 727,505, owned by Warren Bros. Co., covering a street pavement; that at the hearing of said application and after the argument had progressed for some time the defendants brought before the Court and exhibited a section of street pavement, which it was claimed had been taken from one of the streets of the City of Washington, D. C., and which it was claimed had been laid during the year 1872 or 1873; and was offered as an evidence of a pavement construction which anticipated the claims of the Warren Patent.

Affiant states that the section of pavement exhibited appeared on its face to anticipate the claims of said patent, and evidently made such an impression upon the mind of the Court that upon presentation of that exhibit the Court felt constrained to refuse the issuance of the preliminary injunction and so stated in making the order in the case.

VALIDITY ACKNOWLEDGED BY CONTRACTOR.

Affiant further states that immediately thereafter further steps were taken to make a thorough examination of the contract and specifications under which said pavement had been laid in the city of Washington; and also to make a careful examination and analysis of the same; and that as soon as said examination had been made, affiant undertook to renew the application for the preliminary injunction before Judge Kohlsaat but was unable to secure a hearing before him, owing to the fact that it was then midsummer and the Judge intended to leave the city until after vacation; at Judge Kohlsaat's suggestion, affiant then attempted to have a re-hearing before Judge Sanborn but was unable to secure a day until early in September during which time the work had been vigorously prosecuted and a large portion of the street torn up and rendered unfit for use; affiant further states that owing to the fact that this street had been torn up and rendered impassable for traffic affiant realized that it

would be impossible to secure the issuance of a preliminary injunction to prevent the further prosecution of work at that time, and the application for said injunction was, therefore, never argued; affiant further states that before further legal steps were taken in this case the contractor to whom the contract for the improvement of Michigan Boulevard had been awarded, compromised and settled its differences with complainant and accepted a license acknowledging the validity and agreeing to use the patent of complainant in further construction of street pavements; that, therefore, the complainant dismissed its suit against South Park Commission and Metropolitan Construction Company, the matter having been settled and adjusted.

ANOTHER VIEW OF SAME CASE.

With reference to this Chicago case, Linn White, Chief Engineer of the South Park Commission, Chicago, Illinois, in an address before the Civil Engineers' Society of St. Paul, on April 7th, 1913, says:

> Some litigation was had in Chicago with the Bitulithic Company, of which the following is a brief statement; in 1909, when the South Park Commissioners let a contract for paving Michigan Avenue from 12th to Jackson Streets with asphaltic concrete, the Bitulithic Company sought an injunction in the Federal Circuit Court. The injunction was denied by one judge but under some legal technicality the

case was reopened before another Federal judge in the same circuit. The injunction was again denied, and as this left the case before the Court in such a shape that any further action would have to be a trial on its merits, the complainants dismissed the complaint and no attempt has since been made to renew it. To reach this partial conclusion in the Courts required over a year, and of course, before then the contract over which the litigation started was completed and the pavement in use. The South Park Commissioners, however, had proceeded to lay other considerable quantities of similar pavements and if good grounds for an injunction had been shown the result would have been to force them to come to terms with the Bitulithic Company and account for royalties in both past and future work. Up to date, considerably over a million yards of asphaltic concrete pavement has been laid in Chicago, and the royalties would amount to a considerable sum.

COMMITTEE ON LAW POINTS.

From the facts as your committee has been able to obtain them, it would seem, with the possible exception of the Chicago case, that the patent has been fully sustained in the courts. It is also a noteworthy fact that the alleged Washington anticipation before the Court in the Chicago case has been held by other courts not to be considered anticipations.

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Of course, as your committee has heretofore intimated, the question of the Warren patents has not been fully closed and probably never will be, for it is always open to the introduction of evidence of new alleged anticipations that have never been before the courts.

ADVISES AGAINST LITIGATION.

However, for this county to litigate with the Warrens the validity of their patent would mean protracted litigation, which would greatly delay highway construction.

MAIN POINT IS ULTIMATE COST.

After all, the point is not whether the Warren patent is valid, but whether the Warren Pavement, with the royalty to be paid in connection with their original cost plus maintenance, is the cheapest pavement in the long run for the county.

PATENT ON FLUSH COAT.

There now remains to be disposed of the question of Warren's patent for their flush coating process.

This patent is No. 695,422, which must be taken with their patents for machine for spreading the flush coat, which are Nos. 791,726 and 691,708. All these patents were sustained by the United States District Court for the Western District of Texas, El Paso Division, by a decree entered in the case of Warren Bros. Co. vs. John Eubank et al., entered on the 13th day of April, 1915. Whether this suit will be appealed we are unable to state. This seems

to be the only case in which the just above named patent rights have been litigated.

DISCUSSES HASSAM PATENTS.

In conclusion on the subject of patents, we desire to discuss the letters patent for the Hassam pavement.

These bear serial Nos. 819,652 and 851,625. These patents were sustained in the District Court of the United States for the District of Oregon by a decree in the case of Hassam Paving Co. et al. vs. Consolidated Contract Co. et al. This decree was filed April 27, 1914. We understand that this suit has been appealed to the United States Circuit Court of Appeals and is now pending there. As far as we have been able to find, the above suit is the only one in which the Hassam pavement has been in litigation.

WOOD BLOCK SHOULD BE TRIED.

During these hearings your committee took the testimony of several gentlemen interested in wood block pavements. However, we understand that the trustees of the Chamber of Commerce have passed a resolution favoring a trial of wood block pavement. Under these circumstances, your committee feels that the trustees have acted upon the special matter of wood block pavement so that little need be said further than what has been heretofore in this report said concerning the general type and behavior of such pavements.

Your committee is unanimous that experiment be made with wood block; however, we think that the experimental pavement should be confined to

units of one mile each and on different roads, and that the experiment be limited to three miles of wood paving. In view of the fact that this pavement in its cost will exceed other standard types, it is thought advisable that the difference in cost be taken care of by those interested in the wood block pavement.

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HERE ARE MAIN RECOMMENDATIONS.

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As a general recommendation, your committee recommends that on grades and sharp curves either brick or Belgian blocks be employed; that if a Belgian block pavement can be laid as cheaply as a vitrified brick pavement on grades and curves, that stone blocks be employed in preference to brick, as it will furnish an avenue for the employment of an Oregon product.

Your committee further recommends that the Warren pavement be employed on the majority of the mileage for the contemplated hard surface improvements of the county.

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In arriving at this conclusion your committee hesitated somewhat in this recommendation as against an asphaltic concrete pavement of the Topeka specifications, and its preference for Warrenite over Topeka is due to the fact that it has been unable to ascertain what the cost of maintenance of the Topeka pavement would be, measured by the minimum period of 15 years, which your

committee believes should be the basis for determining the maintenance charge.

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If, however, a pavement of the Topeka specifications is to be considered, the question of type of foundation becomes an important one. It would seem to your committee that this pavement, if requiring a new foundation, should have a foundation of either a concrete base or the bituminous base which, of course, would eliminate a crushed rock base.

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Your committee is of the opinion, however, that if the Topeka specification pavement were to be used on the roads at the present time improved with macadam, that the macadam base would furnish a sufficient foundation for this pavement. To again emphasize the point of your committee, it eliminates asphaltic concrete of the Topeka specifications and gives preference to Warrenite purely upon the ground of lack of information with reference to the probable life and cost of maintenance of the pavement of the Topeka specifications.

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During our investigations it was stated to us by a member of the firm of Warren Bros. that it was the policy of their company, when their pavement was used, not to exact royalty for future flush coating or for repairs with the Warren mixture. This, of course, should be reduced to contract form so that there can be no possible misunderstanding upon this point. The opportunity for the county

to avail itself of such privileges if it may so desire, without the payment of royalty, of course is of vital importance.

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Your committee is unable to recommend the use of sheet asphalt pavement on the county highways owing to the fact that when damp it is extremely slippery; also, your committee is convinced that the cost of repairs for this type of pavement is comparatively high.

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Your committee, at this time, does not deem it necessary to discuss the question of a separate maintenance contract for the pavements after they are once laid, as it understands that this matter has been satisfactorily disposed of by asking for bids for maintenance under a contract separate from the specifications that call for bids for original construction.

CONFIDENCE IN JOHN B. YEON.

In conclusion, your committee takes this opportunity to express its confidence in the honesty and integrity of Mr. John B. Yeon, roadmaster of the county. Mr. Yeon, without compensation, is giving all of his time and abilities to this very commendable plan of constructing a permanent highway system. Your committee has found him well grounded and informed on the subject of pavements, and it is the opinion of your committee that the only motive Mr. Yeon has in his views and activities is that of obtaining the very best pavement for the least amount of money. By this we

do not mean the cheapest pavement in first cost, but the pavement that will ultimately be the cheapest. Whether Mr. Yeon is mistaken in his conclusions, whether your committee is mistaken in its conclusions, can only be revealed by the future.

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But, of this we are certain—that everybody concerned in this paving problem who is entirely disinterested has been and is now seeking to get the very best available pavement for the county, because it is realized that in so doing the county will be furnishing an object lesson which will be an incentive to depart from the unwise policy of the past, which has resulted in throwing money away for useless macadam roads.

Respectfully submitted,
F. W. MULKEY, Chairman,
RODNEY L. GLISAN.
FRANK McCRILLIS.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 22.

MR. YEON'S REPORT.

Following is the full text of Roadmaster John B. Yeon's report, with reference to types of paving

and awards of contract for Multnomah County hard-surfacing under the recent bond issue.

Hon. Board of County Commissioners—

Gentlemen:—

As per your order of June 15, 1915, referring to the tabulation, conference and recommendation, with your Honorable Body, I have the honor to submit to you the following report and recommendations for the awarding of contracts for paving the County Roads under the recent Bond Issue of $1,250,000.

I have given each of the different types of pavement bid on careful study and investigation, and have gone into the analysis of the bids fully and with the intention of looking after the best interest of the tax-payers of Multnomah County.

Each section of each road has been considered as a separate bid, and the bids compared on the basis of lowest responsible bidder for the type of pavement best suited for that particular locality, the type of transportation, and further increase of traffic.

Due weight has been given the type of pavement best suited for this climate and on the new subgrades where settlement is likely to occur, or on dangerous curves or grades.

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In my recommendation I have endeavored to choose a pavement with the best point, taking into consideration the money available, as well as the lowest responsible bidder.

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SAFE GRADES—The pavements on safe grades, up to 5 per cent., have been chosen with the following points in view:

First, cost, maintenance cost, imperviousness, resiliency, density, stability, noiselessness, dustlessness, and a pavement that will be easy on the eye; afford a good footing for horses as well as for rubber tires; one that will not crack and will show least abrasion; one that has least tendency among the asphaltic concretes to wave, creep, mark or displace.

Time and ease of construction are two of the most important points taken into consideration, as these two points have a direct bearing on the obstruction of traffic and the resulting inconvenience and loss therefrom.

Consideration has been given the maintenance cost after the first period of ten years and the pavement chosen which will be least expensive to resurface at the end of that time or at a later time.

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STEEP GRADES AND CURVES—On steep grades and curves a pavement has been chosen that will offer the best footing, either because it has a naturally rough surface or because it can be given a rough finish.

In the choosing of these pavements it was necessary to choose the best type for the available money with due regard to the lowest responsible bidder.

REMARKS ON ASPHALTIC CONCRETE NO. 2—I do not favor Asphaltic Concrete No. 2 (Modified Topeka) for the following reasons: High cost

of maintenance, general lack of stability, slipperiness, tendency to creep and tendency to wave. This pavement has not given satisfaction as a highway pavement and is still more or less in the experimental stage.

One of the best arguments against it is the fact that few bids were received on this type, and the general desire to dodge the maintenance.

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REMARKS ON CONCRETE—I do not favor the use of concrete, excepting on steep grades, and then only the Wayne County Specifications (Cement Concrete No. 1) with roughened surface.

Concrete has a tendency to crack and does crack on all roads where it has been laid, thus allowing the water to penetrate to the subgrade. When repaired this crack causes a severe impact from wheels with raveling or increased abrasion. Expansion joints cause the same result.

Concrete is a good base for a bituminous surface but the fact remains that it is much cheaper to build it in that manner at first instead of using bitumen as a final wearing surface, thus saving the cost between a concrete pavement and a concrete base, which is a large item.

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SUMMED UP—I have the following reasons for believing that a concrete pavement is not good in highway construction without a bituminous wearing surface:

Concrete is brittle, hard and unyielding; dusty, noisy and unsightly. Its tendency to crack is a

serious fault, and the difficulty of resurfacing and repairing makes the final maintenance expensive.

The glare from a concrete pavement causes machines to avoid it, and is a serious objection.

Concrete cannot be used for 30 days after construction or repairs, and the construction is slow work, and results in inconvenience to transportation. This would not only mean the closing of the highway to all traffic during construction but for 30 days after, on each division. On the Columbia River Highway where there are fills that cannot be paved this year, it would mean the closing of traffic next year during construction and 30 days thereafter. Any repairs removing concrete would close the road to traffic for at least 35 days.

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No consideration has been given bids which would be liable to involve the County in law-suits, and only pavements have been recommended which come within the available bond issue for each road.

COLUMBIA RIVER HIGHWAY, ESTIMATE $468,007.00

I recommend, that Section "A," Columbia River Highway be awarded to the Warren Construction Company, at the unit prices bid for Asphaltic Concrete No. 1 (*Bitulithic*) on a crushed stone base, Totaling.....$121,077.52

I recommend that Section "B," Columbia River Highway be awarded to the Warren Construction Company, at the unit prices bid for Asphaltic Concrete No. 1 (*Bitulithic*) on a crushed stone base, Totaling..... 29,806.62

I recommend that Section "C," Columbia River Highway be awarded to the Warren Construction Company, at the unit prices bid for Asphaltic Concrete No. 1 (*Bitulithic*) on a crushed stone base, Totaling..... 137,279.50

I recommend that Section "D," Columbia River Highway be awarded to the Pacific Bridge Company, at the unit prices bid for Asphaltic Concrete No. 1 (*Bitulithic*) on a crushed base, Totaling 155,332.78

I recommend that Section "E," Columbia River Highway be awarded to Boyajohn-Arnold and Hans Pederson, at the unit prices bid for brick on a *concrete base,* Totaling..... 22,921.66

TOTAL BID $466,418.08

SANDY ROAD, ESTIMATE $221,925.00

I recommend that Section "A," Sandy Road, be awarded to the Warren Construction Company, at the unit prices bid for Asphaltic Concrete No. 1 (*Bitulithic*) on an old macadam base, Totaling.....$198,690.90

I recommend that Section "B," Sandy Road, be awarded to the Warren Construction Company, at the unit prices bid for Asphaltic Concrete

No. 1 (*Bitulithic*) on an old macadam base, Totaling 16,159.17

TOTAL BID $214,850.07

BASE LINE ROAD, ESTIMATE $152,266.00

I recommend that Section "A," be awarded to the Clark-Henry Construction Company, at the unit prices bid on Asphaltic Concrete No. 1 (*Bitulithic*) on an old macadam base, Totaling $132,493.20

I recommend that Section "B," Base Line Road, be awarded to the Clark-Henry Construction Company, at the unit prices bid on Asphaltic Concrete No. 1 (*Bitulithic*) on an old macadam base, Totaling..... 15,886.20

TOTAL BID $148,379.40

FOSTER ROAD, ESTIMATE $76,303.00

I recommend that the Foster Road be awarded to Giebisch & Joplin, at the unit prices bid on Asphaltic Concrete No. 1 (*Bitulithic*) on an old macadam base, Totaling..... $70,976.95

POWELL VALLEY ROAD, ESTIMATE $128,935.00

I recommend that the Powell Valley Road be awarded to Oskar Huber at the unit prices bid on Asphaltic Concrete No. 1 (*Bitulithic*) on an old macadam base, Totaling..... 121,603.90

CAPITOL HIGHWAY, ESTIMATE $95,814.00

I recommend that the Capitol Highway be awarded to Giebisch & Joplin, at the unit prices bid on Asphaltic Concrete No. 1 (*Bitulithic*) on an old macadam base, Totaling..... 89,988.74

CANYON ROAD, ESTIMATE $39,350.00

I recommend that Section "A," Canyon road, be awarded to Boyajohn-Arnold Hans Pederson, at the unit prices bid on Asphaltic Concrete No. 1 (*Bitulithic*) on a crushed stone base, Totaling $16,903.60

I recommend that Section "B," Canyon Road, be awarded to Montague-O'Reilley Company, at the unit prices bid on *Cement Concrete* No. 1, inclusive of *Armor joints-Crushed stone aggregate,* Totaling..... 22,352.00

TOTAL BID $39,255.00

This recommendation is based on the fact that this section is on a 7½ per cent grade and there were no bids submitted on brick for this section which were low enough to come within the amount appropriated.

ST. HELENS ROAD, ESTIMATE $67,400.00

I recommend that Section "M," St. Helens Road be awarded to the Warren Construction Company, at

the unit prices bid on Asphaltic Concrete No. 1 (*Bitulithic*) on a crushed stone base, Totaling..... $28,537.03

I make no further recommendation on the St. Helens Road for the reason that other bids will exceed the estimate.

I would recommend that as soon as the final decision has been made on any section that the contract for the same be promptly awarded and not wait for a decision on all the roads, so that work can be immediately started as the season is getting short and the delay will prove expensive.

In conclusion I would recommend that an unquestionable and substantial maintenance guarantee be furnished by the successful bidder for the full ten years.

Due to the fact that the District Attorney's Office has continuously opposed the ten year maintenance guarantee, claiming that it could not be legally enforced, I would recommend that the greatest care be exercised by the Board in selecting the class of pavement that is beyond an experimental stage.

The eyes of the whole of Oregon are on Multnomah County and the example set will have great influence in the upbuilding of our State. A mistake of not selecting a proper pavement will handicap the progress of the good roads movement.

Respectfully submitted,

JOHN B. YEON,

Roadmaster.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 23.

THE BITULITHIC PAVEMENT
(Patented by)
WARREN BROTHERS COMPANY
BOSTON, MASSACHUSETTS

AGREEMENT

Boston, Mass., July 9th, 1917

To the Honorable State Highway Commission,
Salem, Oregon.

GENTLEMEN:—

Inasmuch as it is deemed advisable by the proper authorities that bids be received for the improvement of the WEST SIDE PORTION OF THE PACIFIC HIGHWAY FROM THE MULTNOMAH COUNTY LINE TO NEWBERG, APPROXIMATELY 15 MILES IN LENGTH—in the STATE OF OREGON with THE BITULITHIC PAVEMENT; and inasmuch as the construction of said pavement requires the use of certain patented processes and compounds; and inasmuch as competitive bidding in the letting of contracts for road improvements is deemed advisable, in order to provide for such competitive bidding, and at the same time secure the adoption of THE BITULITHIC PAVEMENT as the kind of pavement to be constructed in the above-named road the under-

signed, Warren Brothers Company, as owner of all patents and processes covering the laying of said BITULITHIC PAVEMENT, hereby proposes and agrees, for the consideration hereinafter named, with the STATE HIGHWAY COMMISSION or with any bidder, to whom a contract may be awarded to pave the above-named road with THE BITULITHIC PAVEMENT, at any time within six (6) months from this date, and who shall enter into a contract with such surety or sureties as may be required by said STATE HIGHWAY COMMISSION to furnish, for the performing of any such contract and for making any repairs which may become necessary during the period of any maintenance guarantee provided for in such contract, the following materials ready for use, service and use of machines, coupled with a free license to use any or all the patents, trade-marks, or trade names now owned or which may hereafter be owned by Warren Brothers Company, necessary to lay said pavement:—

1. The necessary roadway mixture for the wearing surface having a thickness of two (2) inches after compression prepared under the patented process of Warren Brothers Company, and delivered hot in the wagons of the Commission Contractor at the BITULITHIC mixing plant located in within three (3) miles of the work to be performed.

2. The right to use any and all patents, trade-marks or trade names now owned or which may hereafter be owned or controlled by Warren

Brothers Company, which are necessary to be used in the laying of such pavement.

3. The seal coat materials necessary for coating the wearing surface, delivered on wagons of the Commission or Contractor at the BITULITHIC mixing plant located as above.

4. The license to use the patented flushcoat bitumen and stone spreading machines, which machines will be furnished by Warren Brothers Company.

5. An expert, who will give proper advice as to the building of such pavement, will be furnished to the Commission or Contractor at the expense of Warren Brothers Company.

6. Two daily examinations of the mixture as delivered on the road will be made at the Laboratory of Warren Brothers Company, to determine if uniformity has been accomplished in the mixture and construction; said samples to be sent, prepaid, to the Laboratory of Warren Brothers Company, Potter Street, East Cambridge, Mass., or 289 East Salmon Street, Portland, Ore., by the Commission or Contractor.

The price at which this service is offered to any and all contractors who make a bid on THE BITULITHIC PAVEMENT, for said road is ninety-four cents ($.94) per square yard of finished pavement, at which price it is also agreed to furnish the materials in barrels for reheating, and the service for making all repairs, if any, which may be necessary for the wearing surface during the life of said patents.

The acceptance of bids by your Commission and

the letting of a contract for the same shall be deemed by Warren Brothers Company to be an acceptance of the proposal by the Commission and by the Contractor to whom such contract shall be awarded, and are all that shall be necessary to bind Warren Brothers Company to this agreement.

This agreement is executed in accordance with the By-Laws of Warren Brothers Company, authority to execute such agreement under said By-Laws being granted to any two of the following officers, viz.: the President, any one of the Vice-Presidents, the Treasurer, the Assistant Treasurer, the General Manager, and the Secretary.

WARREN BROTHERS COMPANY
By W. B. WARREN,
And HERBERT M. WARREN.

[Stamped]: IT IS FURTHER UNDERSTOOD AND AGREED that WARREN BROTHERS COMPANY shall not be required to commence or proceed with said work and shall be allowed reasonable extension of time to complete the same, if they by the exercise of due diligence are unable to obtain materials and labor necessary for the prosecution of this contract by reason of railroad embargoes, governmental requisition of railroads and other war measures or by reason of fire, flood, the common enemy or other cause outside the control of WARREN BROTHERS COMPANY.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 24.

THE BITULITHIC PAVEMENT

(Patented by)

WARREN BROTHERS COMPANY

LICENSE AGREEMENT

Boston, Mass. July 9th 1, 1917.

To the Honorable State Highway Commission,
Salem, Oregon.

Gentlemen:

INASMUCH as it is deemed advisable by the proper authorities of the STATE HIGHWAY COMMISSION, State of OREGON, that bids be received for the improvement of the WEST SIDE PORTION OF THE PACIFIC HIGHWAY FROM THE MULTNOMAH COUNTY LINE TO NEWBERG, APPROXIMATELY 15 MILES IN LENGTH with THE BITULITHIC PAVEMENT under and in accordance with the specifications of the STATE HIGHWAY COMMISSION, and

INASMUCH as the said improvement contemplated requires the laying of a certain patented pavement wearing surface, and as competitive bidding in the letting of contracts for the said improvement is deemed advisable, and

WHEREAS, Warren Brothers Company is unwilling to allow said pavement or roadway, which involves the use of patents and processes owned and controlled by it, to be used unless the BITU-

LITHIC CEMENT specified in the specifications be used;

NOW, THEREFORE, in order to provide for such competitive bidding and at the same time assure the adoption of the said BITULITHIC as the kind of pavement or roadway to be constructed on said road the undersigned Warren Bros. Co., a corporation, as owner of patents and processes covering the said BITULITHIC PAVEMENT, and the laying and construction thereof, for the consideration hereafter named, hereby proposes and agrees to grant to the STATE HIGHWAY COMMISSION and to any bidder to whom a contract may be awarded, and who shall enter into a contract with the STATE HIGHWAY COMMISSION six months from the date hereof, or at any time thereafter until this proposition is formally withdrawn, the right and license to use any and all patents and processes owned and controlled by Warren Brothers Company, which are necessary to be used in the laying of said BITULITHIC PAVEMENT and the perpetual right to use the patented pavement or roadway so constructed, and to furnish the following as specified in and required under and by said specifications:

1. The necessary suitable paving plant, f. o. b. cars at nearest railway station to the proposed work or roadway; said plant to be kept in repair by the STATE HIGHWAY COMMISSION or contractor and to be reloaded on cars on completion of the work in as good condition as when received, ordinary wear and tear excepted.

2. The necessary special street tools (not including shovels, picks, wheelbarrows, etc.) as follows: Flushcoat spreading machine, fire wagon, tampers and street kettle.

3. The necessary BITULITHIC CEMENT, including the BITULITHIC CEMENT for the surface finish or seal coat course for a pavement or roadway constructed under the said specifications; said material to be delivered f. o. b. cars at the nearest railway station to the proposed work or roadway.

4. We will make daily examination at our laboratory of the mixture as delivered on the street or roadway to see that uniformity has been accomplished in the mixture and construction.

5. We will also furnish the successful bidder expert advice in connection with the BITULITHIC PAVEMENT and the contractor bidding under this agreement hereby binds himself to at all times comply with such advice or inspection on the part of Warren Brothers Company's inspectors as to the mixing, selecting and combining of materials entering into the wearing surface, and the spreading and compressing of same, and in the application of the surface finish or seal coat.

6. The price at which said material and the right and license to use said patents and processes is offered to the STATE HIGHWAY COMMISSION and to all contractors who may bid on the BITULITHIC PAVEMENT is sixty (60) cents ($.60) per square yard of finished pavement laid to a thickness of two (2) inches after thorough

compression, which shall include the right and license to use all patents and processes necessary to be used in the laying of said BITULITHIC PAVEMENT street or road, owned and controlled by Warren Brothers Company, and the perpetual right to use the patented roadway so constructed and all the BITULITHIC CEMENT necessary for the construction of the BITULITHIC pavement.

7. If the contractor has a plant suitably equipped to manufacture the BITULITHIC surface mixture, and desires to use said plant and special street tools as covered by paragraphs 1 and 2 above, then Warren Brothers Company hereby agrees to make a reduction of seven (7) cents per square yard in license agreement as above set forth, provided the suitability of such plant and special equipment is passed on by the engineer in charge of the work, said engineer to give Warren Brothers Company an opportunity to submit to him their opinion regarding the suitability of said plant before passing on same.

8. If the contractor lays the surface thicker than the two (2) inches covered by this license, or if it becomes necessary for him to relay any surface, due to faulty foundation or contour or otherwise, then Warren Brothers Company shall be reimbursed for all BITULITHIC CEMENT so used in excess of what is required in said two (2) inches.

The procuring of said BITULITHIC CEMENT from Warren Brothers Company and the exclusive use thereof in the construction of said improvement,

and the construction of the said BITULITHIC pavement in accordance with the license agreement will release the STATE HIGHWAY COMMISSION and the officials thereof, as well as the contractor, from any and all claims for royalty arising or to arise by reason of the construction of said proposed street or roadway.

The execution of the contract for the said work by the successful bidder and the authorities of said STATE HIGHWAY COMMISSION as required by law, shall bind the undersigned Warren Brothers Company to furnish the material and grant the license herein referred to to the contractor at the price herein offered.

The word "contractor," as used herein, shall be deemed to include not only such successful bidder with whom such contract may be made and entered into, but also the said STATE HIGHWAY COMMISSION if it shall elect to itself make or lay such BITULITHIC pavement.

Respectfully submitted,
WARREN BROTHERS COMPANY,
By W. B. WARREN,
Vice-President.

Attest—A. J. HILL.

[Stamped]: IT IS FURTHER UNDERSTOOD AND AGREED that WARREN BROTHERS COMPANY shall not be required to commence or proceed with said work and shall be allowed a reasonable extension of time to complete the same, if they by the exercise of due diligence are unable to obtain materials and labor necessary for the

prosecution of this contract by reason of railroad embargoes, governmental requisition of railroads and other war measures or by reason of fire, flood, the common enemy or other cause outside the control of WARREN BROTHERS COMPANY.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 25.

THE BITULITHIC ROAD
(Patented by)
WARREN BROTHERS COMPANY
BOSTON, MASSACHUSETTS
AGREEMENT

Boston, Mass., May 24th, 1915

To The Honorable County Commissioners of Multnomah County, Oregon.

GENTLEMEN:—

Inasmuch as it is deemed advisable by the proper authorities of County of Multnomah, State of Oregon that bids be received for the improvement of Columbia River Highway, designated by the County Commissioners as Section "E" with the BITULITHIC; and inasmuch as the construction of the said road requires the use of certain patented processes and compounds; and inasmuch as competitive bidding in the letting of contracts for such improvement is deemed advisable, in order to provide for such competitive bidding, the under-

signed, Warren Brothers Company, as owners of all patents and processes covering the laying of said BITULITHIC, hereby proposes and agrees for the consideration hereinafter named, to furnish to the County of Multnomah or to any bidder to whom a contract may be awarded to improve said Road with the BITULITHIC within one (1) year from this date, and who shall enter into a contract with such surety or sureties as may be required by said County of Multnomah all of the materials required for the construction of the wearing surface two (2) inches in thickness after compression and surface finish course, as follows:—

The wearing surface mixture prepared under the patents of Warren Brothers Company.

The flushcoat composition, together with the use of flushcoat spreading machines for spreading the flushcoat composition and the sand, gravel or stone screenings for the surface finish course.

All of said materials to be delivered to the contractor at plant erected within four (4) miles of the place where the said materials are to be used, for the sum of ninety-eight (98) cents per sq. yd. of finished pavement for such materials furnished; said price including the right to use the patents referred to.

The acceptance of bids by the County of Multnomah and the letting of a contract for the same shall be deemed by Warren Brothers Company to be an acceptance of this proposal by the County of Multnomah and by the Contractor to whom such contract shall be awarded, and are all that shall

be necessary to bind Warren Brothers Company to this agreement.

Respectfully submitted,
WARREN BROTHERS COMPANY,
By W. B. WARREN,
And ALBERT C. WARREN,
Secretary.

I, Ralph L. Warren, General Manager, of WARREN BROTHERS COMPANY, hereby certify that under the by-laws of said Company, authority to execute this agreement is granted to any two of the following officers of the Company, viz.:—the President, any one of the Vice-Presidents, the Treasurer, the Assistant Treasurer, the General Manager and the Secretary; and that this agreement is executed by the proper officers of said Company by virtue of said authority.

Witness my signature and the seal of the Company this 24th day of May, 1915.

RALPH L. WARREN,
General Manager.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 29.

(COPY)

BLOCK No. 99, EAST DENVER, BETWEEN ARAPAHOE AND CURTIS, AND 14TH AND 15TH STREETS.

BLAKE PAVING CO.

PERMIT NO. 7284—ISSUED JULY 11, 1892.

State of Colorado,
City and County of Denver.—

Agnes M. Robertson, 624 West Colfax Avenue, Denver, Colorado, being first duly sworn, upon oath, deposes and says: That the following is a true and correct copy of the AGREEMENT AND SPECIFICATIONS under which THE BLAKE ASPHALT COMPANY constructed the paving in the alley lying between Arapahoe, Curtis, 14th and 15th streets in the City of Denver, under Permit No. 7284 issued by the City of Denver on the 11th day of July 1892.

AGNES ROBERTSON.

Subscribed and sworn to before me this 10th day of July, 1915.

My commission expires April 12, 1915.

[Seal] FRANK J. EMPEROR,
Notary Public.

(COPY)

THIS AGREEMENT, made and entered into this 8th day of July, A. D. 1892 by and between the subscribers to this instrument hereinafter named,

of the first part and THE BLAKE ASPHALT COMPANY, a Corporation, of the second part,

WITNESSETH:

THAT THE BLAKE ASPHALT COMPANY hereby agree to make all necessary excavations to grade and subgrade, furnish all necessary materials and labor, and therewith construct an asphalt pavement, in accordance with plans and specifications hereto attached and made a part of this contract, under the direction and to the satisfaction of the city engineer of the city of Denver, in the Alley upon which the lots described and set opposite the subscribers' names, abut, in the East division of the city of Denver, hereby agreeing and guaranteeing to maintain said pavement in good repair for the period of five years from and after the completion of the same, without further cost or expense to the subscribers. The cost of construction, maintenance, and repair, to be paid for by the parties of the first part at the rate of two and 40/100 dollars per foot of the frontage of the several lots of the subscribers, abutting upon said alley.

This agreement shall be binding upon said company, when, but not until all of the said frontage shall have been subscribed for by parties of known responsibility.

The said THE BLAKE ASPHALT COMPANY agrees to begin said work within 60 days after all of said frontage has been subscribed for, and prosecute the same without delay and with reasonable diligence until completed.

IN CONSIDERATION WHEREOF, the subscribers hereto, parties of the first part, respectively agree, that they are the owners of the several lots and parcels of land described opposite their respective names, and that they will respectively pay THE BLAKE ASPHALT COMPANY the several sums set opposite their respective names, as and for their respective shares of the cost of said improvement, the same to be paid in cash upon the original completion of said pavement; the amount due for such improvement to be a lien on their respective premises until paid, and it is mutually agreed that the obligation created by this instrument shall be several and not joint.

And the subscribers hereto, parties of the first part, and each of them, hereby authorized the said THE BLAKE ASPHALT COMPANY to make application in our names for the necessary permit or permits for grading and paving said alley; and we hereby authorize the said THE BLAKE ASPHALT COMPANY to act as the attorney in fact for all and each of us in signing any or all of our names to any and all petitions necessary or proper or required to be made in petitioning for paving or other improvements under the ordinances of the city of Denver or the laws of the state of Colorado.

IN WITNESS WHEREOF THE BLAKE ASPHALT COMPANY, party of the second part, has caused these presents to be signed by its Manager this 8th day of July, A. D. 1892, and the parties of

the first part, subscribers hereto, have hereunto set their hands on the several dates set opposite their respective names.

THE BLAKE ASPHALT COMPANY.

(Sgd.) By F. O. BLAKE,

Mgr.

DATE	SUBSCRIBERS	LOT	BLOCK	FRONTAGE	AMOUNT.
Signed	The Colorado Mining Stock Exc.	1, 2, 3, 4,	99		100
"	The Colorado News Co.	5	"		25
"	Estella Hoyt	7, 8,	"		50
"	The Jefferson Investment Co.	10, 11, 12	"		75
"	The Colorado Seminary	½ 14, 15, 16	"		62½
"	Robert McElvanney	13½ of 14	"		37½
"	Lester Babcock	17 and 18	"		50
"	Estate Frank A. Howard	19, 20½, 21	"		62½
"	Oscar R. Young	½ of 21 and 22	"		37½
"	C. J. Reilly	23			25
"	Fannie J. Gothe	24			
"	William Malonies	9			25
"	Chas. Wheeler	25, 26			50
"	Mary Cella	27, 28			50
"	Hughes Estate	29, 30, 31 and 32			100

SPECIFICATIONS FOR PAVING DONE BY THE BLAKE ASPHALT COMPANY.

FIRST: Alleys shall have asphalt topping 1½″ thick when compressed, with base of asphaltic concrete 4½″ thick, the whole forming one solid mass 6″ thick.

SECOND: The space over which the paving is to be laid shall be excavated to a depth of 6″ below the proposed surface line of the pavement. All objectionable or unsuitable material below subgrade shall be removed and the space filled to subgrade with clean sand and gravel. The subgrade after having been perfectly puddled by the use of water through hose or other necessary appliances shall be trimmed and then thoroughly rolled with a steam roller weighing not less than five tons and shall then be retrimmed; the rolling and trimming to be continued until the subgrade is completed in a thorough and workmanlike manner, or to the satisfaction of the city engineer. All soft places that cannot be reached by the roller, shall be dug out and refilled in layers and hand tamped or puddled or both, as may be necessary, or directed by the city engineer.

All excavated materials shall be removed at once from the work and deposited by the contractor at points to be designated by the city engineer.

THIRD: Upon the bed thus prepared and brought to sub-grade will be laid a base of asphaltic concrete composed as follows:

Asphalt 8 per cent to 10 per cent; sand and gravel 90 per cent to 92 per cent, the whole to be thoroughly

mixed while hot and tamped or rolled to a true surface and must be 1½′ below the finished surface of the ——.

FOURTH: The wearing surface or topping will be composed of asphalt cement 15% to 20%.

Clear sharp sand, 65% to 70%.

Powdered carbonate of lime 10% to 15%.

The asphalt must be equal at least to Trinidad Asphalt and unmixed with the products of coal tar, and may be reduced with a sufficient quantity of residuum not to exceed 15%.

The sand and asphalt are to be heated separately to about 300 deg. F.

The carbonate or sulphate of lime while cold must be mixed with the hot sand, and the asphalt cement added to the mixture, and the whole now well and thoroughly mixed and brought on the ground at not less than 240 deg. F., and spread compressed and smoothed by rollers or smoothing irons to the true surface of the established grade.

Denver, Colorado, April 10, 1915.

Received from WARREN BROS. CO. $7.00 for copying this agreement and specifications.

AGNES M. ROBERTSON.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 30.

HAMILTON CITY CORPORATION.
BOARD OF WORKS DEPARTMENT.

Specifications for Tar Macadam Roadways.

EXCAVATION.

All earth or other material above the sub-grade shall be excavated, so as to conform to the level of the sub-grade, which will be ten inches below the finished surface of the roadway; and should the sub-grade be above the level of the natural ground, then earth shall be deposited until the level of the sub-grade is reached. The sub-grade shall be shaped to the profile and cross section which will be furnished by the City Engineer.

ROLLING.

After the sub-grade has been formed to the proper camber of the road, generally ½ inch per foot or 6 inches for 24 foot roadway, to be thoroughly rolled with the steam road roller, and if by this means soft spots are revealed, they shall be filled with good solid material.

SIZE OF STONE.

The first six inches shall be made in the ordinary way for a Macadam or Telford roadway thoroughly rolled. If so required, it may be made of hard broken stone, furnace clinkers, or brick rolled smooth and finished to the required camber of the road. Upon this shall be placed the tarred stone. The first layer—three inches of hand broken stone to pass through a 2½ inch ring, then a two inch

layer of machine broken stone, the whole smoothed off with a hand roller and after top dressing is applied thoroughly rolled with a steam roller. On this a layer composed of fine gravel and quarry chippings, mixed in equal proportions, three-quarter inches thick, shall be placed, and well rolled in so as to fill all interstices. Before finishing, a dressing of stone screenings for the purpose of coloring shall be scattered broadcast to be worked in by the traffic. All layers, including the coloring layer, shall be thoroughly compacted by rolling.

METHOD OF MIXING TAR.

The stone to be tarred shall if moist be heated on an iron floor, under which are flues from a fire, until the moisture is driven out. The material in its heated state is then to be thoroughly mixed with a sufficient quantity of tar. The broken stone in warm weather may be sun dried but in all cases the finer course must be artificially dried. At the same time care must also be taken not to get this material too hot. The tar should be boiled in iron kettles holding one hundred imperial gallons. Eight imperial gallons should be added to each cubic yard of the coarser material or more if required to completely cover the stone, and seventeen to eighteen gallons to the finer kinds of stone.

TAR.

The tar must be pure Coal Tar free from all foreign substances and containing not more than 5 per cent of water and shall contain upon analysis not less than 55 per cent pitch.

WEATHER.

The work must be done in the summer months, and all work must be suspended during wet weather.

E. B. WINGATE,
City Engineer.

City Engineer's Office, Hamilton, August, 1900.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk. No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 31.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk. No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

ADVERTISEMENT

Which is to be Included and Considered as Part of this

CONTRACT.

DEPARTMENT OF PUBLIC WORKS.

1893.

TO CONTRACTORS.

SEALED PROPOSALS for the improvement of North Highland Avenue from Bryant Street northerly, will be received at the office of the City Controller until the 27th day of May, at 2 o'clock, P. M.

a. The City of Pittsburgh reserves the right to reject any or all bids, should they deem it for the interest of the City.

b. No contract shall be awarded to any person in arrears to the City, from any cause; or who may have, in former contracts with the City, failed to perform work satisfactory, either in the character of the work or the time unnecessarily consumed in its completion by neglect or wilful delay.

c. The estimated quantities for paving, curbing and otherwise improving North Highland Avenue as shown on Letting Plan, No. 189, are to be considered and taken as APPROXIMATE, and the right is expressly reserved by the party of the first part to this agreement, to increase or diminish the said quantities. Nor shall any change of grade, alignment, or otherwise vitiate, annul or impair the contract made and entered into relative to said work, nor constitute any claim for compensation on account of prospective profits. The contractor shall be paid for the amount of work actually performed, at the rates specified in the proposal therefor, and annexed to this contract as part thereof. The full measure of compensation to the contractor to be determined by the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys, whose final estimate of said work shall be conclusive evidence thereof, and of binding force.

d. The prices bid are to cover the furnishing of all materials entering into the construction of the work, and the necessary labor and tools required to

perform the work in strict accordance with the plans and specifications of said work.

e. Bidders will be required to accompany their proposals with a "Bond" for one-half the estimated cost of the work, including all material duly and legally executed by the party or parties making the proposals, with two freeholders of the County of Allegheny as sureties thereon, each of whom shall certify before the Mayor or City Clerk that he is or they are worth over all encumbrances the full amount of the proposed bond, and such bond before such contract shall be binding upon the City shall first have been approved by Councils, and which bond shall be held as security for the payment of any difference between the sum to which the contractor would be entitled to on the completion of the work at the price stated in the proposal, and that which the City of Pittsburgh may be obliged to pay to any higher bidder at any subsequent letting should he or they refuse to sign the agreement or perform the work satisfactory in accordance with the plans and specifications relating to and regulating the same. With the further conditions that the said City of Pittsburgh shall be indemnified against all loss, costs and damages which may arise from the non-fulfillment of this contract in any manner whatever, or for or by reason of any failure of any kind whatsoever upon the part of the said contractor to perform fully and faithfully all the terms and conditions therein named and contained.

f. The party or parties to whom the contract shall be awarded will be required to attend at this

office within five (5) days from the date of award to sign the agreement, and in case of failure or neglect so to do, he or they will be considered as having abandoned it, and as in default to the said City; and thereupon the Chief of Department of Public Works may re-advertise said work to be re-let as before, and so on, until the contract be accepted and agreement executed.

g. In no case will contractors be allowed to use materials other than of the quality and dimensions prescribed in the plans and specifications, or which may be specified by the Superintendent of Engineering and Surveys.

h. Bidders will examine for themselves the location of the proposed work, so that no misunderstanding may exist in regard to the nature of the work to be done.

i. Bidders will be furnished with blanks at this office and none other will be accepted.

N. B.—Bidders are particularly notified, that a provision in the contract requires the contractor to keep continuous in repair the said work or improvement for the full period of 5 years after the completion and acceptance of the same at the expense of said contractor. In all cases where stone masonry is required, the same shall be paid for at a price per cubic yard, the number of yards to be ascertained and determined by the actual cubical contents thereof, without any allowance on account of face measurement.

FORM OF AGREEMENT,

To be Executed for the Improvement of North Highland Ave., from Bryant Street northwardly.

Made and concluded this 15th day of July, A. D. 1893, by and between the City of Pittsburgh, through the Chief of Department of Public Works, duly authorized thereto by an ordinance of the Councils of said City, approved 22d day of April, A. D. 1893, party of the first part, and Booth & Flinn Ltd. of Pittsburgh, Pa., Contractor, parties of the second part.

WITNESSETH, That the said parties of the second part have agreed, and by these presents do agree with the said party of the first part, for the consideration hereinafter contained, and under the conditions set forth in a "bond" bearing date May 25, 1893, and hereunto annexed and made part thereof to furnish, at their own proper cost and expense, all the necessary materials, labor and tools, to repave and curb, in a good and substantial manner N. Highland Ave. from Bryant St. northwardly under conditions and in compliance with the following

SPECIFICATIONS.

Grading.

Materials, how paid for.

1. To include all materials on the street, both on roadways and sidewalks. All surplus material to be deposited as the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys may direct. The contractor not to be paid for both excavating and

filling, but for whichever contains the greater number of cubic yards. All the materials furnished and all the work done, which, in the opinion of the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys, shall not be in accordance with this specification, shall be immediately removed, and other materials furnished and work done, which shall be in accordance therewith.

vork, prose-

2. The work under this agreement is to be prosecuted at and from as many different points in such part or parts of the street, on the line of the work, as the said Superintendent of Engineering and Surveys may from time to time direct.

of nsion.

3. The right to construct any sewer or sewers, or receiving basins and culverts, or build up or adjust any manholes, or to re-set or renew any frames and heads for sewer manholes in said street, and to grant permits for house connections with sewers, or with water or gas pipes, at any time prior to the laying of the new pavement over the line of the same, is expressly reserved by the said Superintendent (and he expressly reserves the right of suspending the work or any portion thereof, on any part of said line of street or streets, at any time during the construction of the same for the purpose above stated, or for any other purpose, without other compensation to the contractor for such suspension, than extending the time for completing the work so long as it may have been delayed by such suspension); and said contractor shall not interfere with, or place any

impediments in the way of any persons or persons who may be engaged in the construction of such sewer or sewers, or in making connections therewith, or doing other work above specified, or in the construction of any receiving basins and culverts, or in setting or re-setting any curb or gutter stones on the line of the street, or in the performance of any other work deemed necessary by the Superintendent of Engineering and Surveys.

PREPARATION OF ROAD-BED FOR ASPHALT PAVEMENTS.

No. 1.

Preparation of Foundation.

All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter (be it earth, rock or other material) shall then be excavated and removed, to the depth of sixteen and one-half (16½) inches below the top line of the proposed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such materials shall be removed, and the space filled with clean gravel or sand and carefully rolled with a steam roller of not less than ten (10) tons weight, so as to make such filling compact and solid. Upon the foundation thus prepared shall be laid a bed of broken stone eight (8) inches in depth when rolled, said stone to be broken that none shall measure more than three (3) inches in any directions nor less than two (2) inches (the stone to be Ligonier or Granite spalls or of hard native stone). This

layer shall be compactly rolled to the satisfaction of the Superintendent of Engineering and Surveys with a steam roller of not less than ten (10) tons weight. Upon this road-bed so rolled shall be laid a layer of Ligonier granite stone four and one-half (4½) inches in thickness when rolled poured with hot composition distilled expressly for the purpose, using not less than one gallon to each square yard, so as to thoroughly permeate all crevices or spaces, thereby making the layer one solid mass, and a binder consisting of clean broken Ligonier granite stone not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters and properly mixed with hot composition through steam mixer, shall then while hot be spread evenly in such quantity as to be two (2) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition well heated and thoroughly mixed through steam mixers shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The binding material which is a cement prepared with refined Trinidad Asphaltum and Heavy Petroleum Oil, unmixed with any of the products of Coal Tar.

The Asphaltic cement shall be prepared in the following proportions:

Refined Asphaltum,	100 parts.
Heavy Petroleum Residuum,	20 "

The wearing surface shall be composed of:

Asphaltic Cement	from	12	to	16	parts.
Sand,	"	73	"	67	"
Pulverized Carbonate of Lime,	"	15	"	17	"

These portions will be varied according to circumstances, as may be necessary to secure the best practical result.

The Sand and Asphaltic Cement are to be heated separately to about 300 deg. Fahr. The pulverized Carbonate of Lime, when cold, will be mixed with the hot sand in the required proportions, and will then be mixed with the Asphaltic Cement at the required temperature in the proper proportion, in an apparatus suited to effect a perfect mixture.

The pavement mixture thus prepared will be brought to the ground in carts, at a temperature of about 250 deg. Fahr., it will then be carefully spread by means of iron rakes, in such a manner as to give a uniform and regular grade, and to such depth that, after having received its ultimate compression, it will have a thickness of two (2) inches. The surface will then be compressed by a hand roller, after which a small amount of hydraulic cement will be swept over it, and it will then be thoroughly compressed by a steam roller, the rolling being continued as long as it makes an impression on the surface.

PREPARATION OF ROAD-BED FOR ASPHALT PAVEMENT.

No. 2.

eparation undation.

All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the subsoil or other matter (be it earth, rock, or other material), shall then be excavated and removed to a depth of nine (9) inches below the top line of the proposed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed, and the space filled with clean gravel or sand, and carefully rolled with a steam roller of not less than ten (10) tons weight, so as to make such filling compact and solid. Upon the foundation thus prepared shall be laid a bed of broken stone six (6) inches in depth when rolled, said stone to be broken that none shall measure more than three (3) inches in any direction, nor less than two (2) inches (the stone to be Ligonier, granite, spalls or of hard native stone). This layer shall be compactly rolled, to the satisfaction of the Superintendent of Engineering and Surveys with a steam roller of not less than ten (10) tons weight; poured with hot composition distilled expressly for the purpose, using not less than one (1) gallon to each square yard so as to thoroughly permeate all crevices, or spaces, thereby making the layer one solid mass, and a binder consisting of clean broken Ligonier granite stone not to exceed one and one-half (1½) inches in diameter, well heated

through revolving heaters and properly mixed with hot composition through steam mixer, shall then while hot be spread evenly in such quantity as to be one and one-half (1½) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition, well heated and thoroughly mixed through steam mixers, shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The binding material which is a cement prepared with refined Trinidad Asphaltum and Heavy Petroleum Oil, unmixed with any of the products of Coal Tar.

The Asphaltic cement shall be prepared in the following proportions:

Refined Asphaltum,	100 parts.
Heavy Petroleum Residuum,	20 "

The wearing surface shall be composed of:

Asphaltic Cement,	from 12 to 16 parts.
Sand,	" 73 " 67 "
Pulverized Carbonate of Lime,	" 15 " 17 "

These portions will be varied according to circumstances, as may be necessary to secure the best practical result.

The Sand and Asphaltic Cement are to be heated separately to about 300 deg. Fahr. The pulverized Carbonate of Lime, when cold, will be mixed with the hot sand in the required proportions, and will then be mixed with the Asphaltic cement at the required temperature in the proper proportions, in an apparatus suited to effect a perfect mixture.

The pavement mixture thus prepared will be brought to the ground in carts, at a temperature of about 250 deg. Fahr., it will then be carefully spread by means of iron rakes, in such a manner as to give a uniform and regular grade, and to such depth that, after having received its ultimate compression, it will have a thickness of one and one-half (1½) inches. The surface will then be compressed by a hand roller, after which a small amount of hydraulic cement will be swept over it, and it will then be thoroughly compressed by a steam roller, the rolling being continued as long as it makes an impression on the surface.

PREPARATION OF ROAD-BED FOR ASPHALT PAVEMENT.

No. 3.

paration

ndation.

All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter (be it earth, rock or other material) shall then be excavated and removed, to the depth of sixteen and one-half (16½) inches below the top line of the proposed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed, and the space filled with clean gravel or sand and carefully rolled with a steam roller of not less than ten (10) tons weight, so as to make such filling compact and solid. Upon the foundation thus prepared shall be laid a bed of broken stone eight (8) inches in depth when rolled,

said stone to be broken that none shall measure more than three (3) inches in any direction nor less than two (2) inches (the stone to be of hard native stone). This layer shall be compactly rolled to the satisfaction of the Superintendent of Engineering and Surveys, with a steam roller of not less than ten (10) tons weight. Upon this road-bed so rolled shall be laid a layer of Ligonier granite stone four and one-half (4½) inches in thickness when rolled, poured with hot composition distilled expressly for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices or spaces, thereby making the layer one solid mass, and a binder consisting of clean broken Ligonier granite stone not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters and properly mixed with hot composition through steam mixer, shall then while hot be spread evenly in such quantity as to be two (2) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition, well heated and thoroughly mixed through steam mixers, shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The binding material which is a cement prepared with refined Trinidad Asphaltum and composition of pitch (expressly distilled for the purpose) commercially known as No. 4.

The Asphaltic Vulcanized cement shall be prepared in the following proportions:

Asphalt,	from 28 to 43 parts.
No. 4 Pitch,	" 72 " 57 "

The wearing surface shall be composed of:

Asphalt Cement,	from 14 to 18 parts.
Crushed Ligonier Stone,	" 43 " 41 "
Sharp River Sand,	" 43 " 41 "

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen with openings of one-fourth (¼) inch, and heated in revolving heaters and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder in such quantity, as when compactly rolled with a steam roller, to be two (2) inches in thickness, the whole making one homogeneous mass.

PREPARATION OF ROAD-BED FOR ASPHALT PAVEMENTS.

No. 4.

Preparation of foundation. All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter (be it earth, rock or other material) shall then be excavated and removed, to the depth of nine (9) inches below the top line of the proposed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed, and the space filled with clean gravel or sand and carefully rolled with a steam roller of not less than ten (10)

tons weight, so as to make such filling compact and solid. Upon the foundation thus prepared shall be laid a bed of broken stone six (6) inches in depth when rolled, said stone to be broken that none shall measure more than three (3) inches in any direction nor less than two (2) inches (the stone to be Ligonier, Granite spalls, or of hard native stone). This layer shall be compactly rolled to the satisfaction of the Superintendent of Engineering and Surveys with a steam roller of not less than ten (10) tons weight. Upon this road-bed when rolled there shall be poured a hot composition distilled expressly for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices or spaces, thereby making the layer one solid mass, and a binder consisting of clean broken Ligonier granite stone not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters and properly mixed with hot composition through steam mixer, shall then while hot be spread evenly in such quantity as to be one and one-half (1½) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition well heated and thoroughly mixed through steam mixers shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The binding material which is a cement prepared with refined Trinidad Asphaltum and composition of pitch (expressly distilled for the purpose) commercially known as No. 4.

The Asphaltic Vulcanized cement shall be prepared in the following proportions:

Asphalt,	from	28	to	43	parts.
No. 4, Pitch,	"	72	"	57	"

The wearing surface shall be composed of:

Asphalt Cement,	from	14	to	18	parts.
Crushed Ligonier Stone,	"	43	"	41	"
Sharp River Sand,	"	43	"	41	"

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen with openings of one-fourth (¼) inch, and heated in revolving heaters and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder in such quantity, as when compactly rolled with steam roller, to be one and one-half (1½) inches in thickness, the whole making one homogeneous mass.

CURBING.

Quality and Size.

The stone to be used for curbing shall be first quality Beaver, Baden or Freeport stone, or equal in quality, free from all defects whatsoever; no stone shall, when dressed, be less than four (4) feet in length (except for closure) and two (2) feet in depth.

No stone shall be less in length on the bottom than on the top, all joints shall be full depth of the stone truly squared so as to make close joints, they shall be smoothly dressed on top for the width of six (6) inches, which width shall be uniform for all stone, three (3) inches on the side next the foot-walk and dressed twelve (12) inches

deep in front; no stone shall be less than six (6) inches in thickness in any part; corner stone shall be cut to a radius of three (3) feet, and in such manner as directed without extra charge.

All to be set true to line and grade. Before any curbstones are set the contractor shall excavate a trench to the depth of three (3) feet below grade line, and twelve (12) inches wide, in which shall be placed and rammed twelve (12) inches in depth of broken stone, slag or such other material as the Superintendent of Engineering and Surveys shall approve, then the curbstones set thereon; in case of embankments or fills no broken stone shall be placed under the curb unless otherwise ordered by said Superintendent of Engineering and Surveys. Broken stone, slag or other material shall be rammed behind the stone to the thickness of six (6) inches, and to the full depth of the stone. The earth, when no stone or slag is required, shall be thoroughly rammed, made perfectly compact and solid before setting the curb; any stone condemned by the said Superintendent of Engineering and Surveys shall be immediately removed from the street or line of improvement.

At each end of any embankment or fill, cross-drains shall be dug from the bottom of the curbstone to any drop, manhole or water-course, without extra charge.

REPAVING.

How done. 16. Whenever a street is to be repaved, the curbstone shall be reset at the price named in the contract; if new curbstones are necessary, the con-

tractor shall furnish them of the standard quality, size and form, to be paid for at the rate agreed upon on said contract. Any material reserved by the Superintendent of Engineering and Surveys shall be placed where he shall direct, without any extra charge therefor.

GENERAL REQUIREMENTS.

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pared.

All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work, the sub-soil or other matter, (be it earth, rock, or other material), shall then be excavated and removed to the depth of sixteen and one-half (16½) inches for No. 1 and nine (9) inches for No. 2, below the top line of the proposed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed and the spaces filled with clean gravel, sand or cinder, carefully rolled with a steam roller of not less than ten (10) tons weight, so as to make such filling compact and solid.

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pection.

The contractor will be required immediately upon the completion of the grading and setting of curbstones, to notify the Superintendent of engineering and surveys when he shall proceed to examine whether the street has the required depth for the reception of the stones; and in no case shall any stones be hauled on the street before such examination shall have been made and the contractor notified to proceed with the work by the Superintendent of Engineering and Surveys.

Similar notice shall be given by the contractor after the completion of the paving.

Damages to be sustained by Contractor.

It is hereby further agreed that all loss or damage arising out of the nature of the work to be done under this agreement, or from any unforeseen obstructions or difficulties which may be encountered in the prosecution of the same, or from the action of the elements, or from any encumbrances on the line of the work, shall be sustained by the contractor.

Meaning of Terms.

Wherever the word "contractor," or the words "party of the second part," or the pronouns in place thereof, are used in this contract, they are to be considered as referring to and meaning party or parties, as the case may be, of the second part to this agreement.

Provisions of Contract.

In all matters not herein specified, this contract shall be subject to the provisions of the Acts of Assembly of the Commonwealth of Pennsylvania, and the Ordinances of the City of Pittsburgh now in force, so far as they are applicable thereto.

Stakes to be preserved.

The contractor shall be required to preserve all stakes that may be set by the Superintendent of Engineering and Surveys on the line of the work, defining grade, curb or street lines; and if he fails so to do, he shall be charged for all the time and expense that may be necessary to replace them by the Superintendent of Engineering and Surveys; he shall also be required to preserve all monuments that may have been placed upon the line of the street, defining its boundaries, and shall in no case be permitted to interfere therewith; and if, in the prosecution of the work, it may be found necessary to remove any such monuments, he shall immedi-

ately inform the Superintendent of Engineering and Surveys of the fact, and the Superintendent of Engineering and Surveys shall attend to the removal thereof. The Superintendent of Engineering and Surveys shall notify the contractor of the location of all such monuments along the line of the work, with instructions to him as to how he may proceed in the locality where such monuments are placed, which instructions are to be faithfully carried out; and if violated by the contractor, or his agents, he shall be liable to pay for all the time and expense that may be incurred in replacing any and all such monuments so moved or misplaced.

Attention to be given to work by Contractor.

The said party of the second part hereby further agrees, that he will commence the work aforesaid on such day, and at such point or points, as the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys may designate, and fully complete the same, in accordance with this agreement, on or before the expiration of days next thereafter, except the time may be extended by the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys; that he will give his personal attention properly to the faithful prosecution of the said work; that he will not sub-let the aforesaid work, but will keep the same under his own control. If at any time any overseer or workman employed by the contractor shall be declared by the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys, to be unfaithful

or incompetent, the contractor on receiving notice shall forthwith dismiss such person, and no longer employ him on any part of the work.

Penalty for delay.

And the said party of the second part hereby further agrees, that the said party of the first part shall be, and is hereby authorized to deduct and retain out of the moneys which may be due or become due to the said party of the second part under this agreement, as liquidated damages for the non-completion of the work within the time hereinbefore mentioned for its completion, the sum of fifty (50) dollars for each and every day the completion of the work is delayed beyond the time hereinbefore stipulated for the completion of the whole of the work under this agreement.

Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys authorized to employ men, if necessary.

The said party of the second part further agrees, that if, at any time the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys shall be of opinion that the said work or any part thereof is unnecessarily delayed, or that the said contractor is willfully violating any of the conditions or covenants of this agreement or is executing the same in bad faith, he shall have power to notify the aforesaid contractor to discontinue all work under this contract, or any part thereof; and thereupon the said contractor shall cease said work, or such part thereof and the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys shall thereupon have the power to place such and as many persons as he or they may deem necessary, by contract or otherwise, to work

at and complete the work herein described, or any part thereof and to use such materials as he may find upon the line of said work, or to procure other materials for the completion of the same, and to charge the expense of said labor and materials to the aforesaid contractor; and the expense so charged shall be deducted from and paid by the party of the first part out of such moneys as may then be due, or may at any time thereafter become due to the said contractor, under and by virtue of this agreement, or any part thereof; and in case such expense is less than the sum which would have been payable under this contract, if the same had been completed by him, he shall be entitled to receive the difference; and in case such expense shall exceed the last said sum, he shall pay the amount of such excess to the party of the first part on notice from the said Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys of the excess due.

Provision to keep and maintain said improvement in good repair.

And the said party of the second part hereby further agree for himself, his heirs, executors, administrators and assigns, that all said work or improvement shall be kept and maintained, at the expense of said contractor, in continuous good repair and condition for the period of five years from and after the completion and acceptance of said work. And it is further agreed, that if, at any time during the said period of five years from the date of the acceptance by said Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys of the work under this

agreement, the said work or any part or parts thereof (excepting only such part or parts of the work as after the completion thereof may have been disturbed in the construction or repairs of sewers or drains, or in laying or repairing of gas or water main and service pipes) shall, in the opinion of the said Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys, require repair, and the said Superintendent of Engineering and Surveys shall notify the said party of the second part to make the repairs so required, the said party of the second part shall immediately commence and complete the same to the satisfaction of said Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys; and in case of failure or neglect on his or their part, within three days from the date of the service of the aforesaid notice to begin the same and faithfully prosecute the same to completion, the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys shall have the right to purchase such materials as he or they shall deem necessary, and to employe such person or persons as he or they may deem proper, and to undertake and complete the said repairs, and to charge the expense thereof to the said party of the second part as before mentioned.

Repairs to be made.

And the said party of the second part hereby further agrees to receive the following prices as full compensation for furnishing all the materials and labor, which may be required in the prosecution and

Compensation.

completion of the whole of the work to be done under this agreement, and in all respects completing the same to the satisfaction of the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys, to wit:

For Grading, per cubic yard, the sum of.....$

1590 sq. yds. for Furnishing and Paving, Asphalt, #4, per square yard, the sum of $2.80

For Furnishing and Curbing, per lineal foot, the sum of .....$ 70¢

For resetting old Curbing, per lineal foot, the sum of .....$ 20¢

For repairing street returns, sq. yd, the sum of .....$ 30¢

as contained in the annexed Proposal:

Measurements, &c.

It being expressly understood and agreed by the parties hereto that the measurement shall be taken after the completion of the work, and the estimate and certificate of the Superintendent of Engineering and Surveys shall be final and conclusive evidence of the amount of work performed by the said contractor under and by virtue of this agreement, and shall be taken as the full measure of compensation to be received by the said contractor without the right of exception or appeal. And that the aforesaid prices cover the furnishing of all the different materials and labor, and the performance of all the work mentioned in this specification and agreement; and in case of any doubt or ambiguity touching any part of this contract or any of the plans or specifications referred to or connected therewith or any

other matter involved therein, the decision thereon by the said Chief of the Department of Public Works shall be deemed, taken and treated as final, binding, conclusive and obligatory upon all parties hereto without the right of exception or appeal.

Terms of Payment and Interest.

It being hereby understood and agreed that the ordinance of the City of Pittsburgh entitled "An ordinance relating to contracts between the City of Pittsburgh and contractors doing public work for the same, regulating the manner and time of payment of material and work done and furnished under such contracts," approved the 20th day of May, 1892, shall be deemed, taken and treated as part of this contract, to wit: in so far as it applies to the time and manner of payment and the interest thereon. The said ordinance reading as follows: "That in all contracts hereafter made between the City of Pittsburgh, and its contractors for the grading, paving and curbing of streets and the construction of sewers, there shall be inserted in such contracts by the Chief of the Department of Public Works, acting for and as the representative of said City, a clause or section as follows, viz.: In consideration of the faithful fulfillment of the contract by the said contractor or contractors as fully set forth and described in the specifications relating thereto, the said City of Pittsburgh shall pay or cause to be paid to the said contractor or contractors, his or their assigns, on estimates and certificates to be furnished by the Superintendent of Engineering and Surveys, approved by the Chief of the Department of Public Works, the full contract price there-

for out of and from the assessments which may from time to time be levied and collected from the properties benefited by the said improvement, as the same shall be ascertained and finally determined in the manner provided by law, and the ordinances of the said City of Pittsburgh relating thereto. That all the assessments shall be collected by the said City of Pittsburgh, or its authorized agents or officers within two years from and after the date of the completion and acceptance of said work. Said assessments when and as often as collected shall be paid by the said City of Pittsburgh upon proper warrants to said contractor or contractors, his or their assigns, as a credit upon the contract price in such contract named. The contractor or contractors, his or their assigns, shall be entitled to have and receive interest at the rate of six per cent. per annum upon all payments from and after the completion and acceptance of said work; provided, however, that the remainder of the assessments uncollected upon such contract with the interest thereon shall be payable by said City of Pittsburgh on and after the expiration of two years from the completion and acceptance of the work in such contract described. It is expressly agreed by the contractor or party of the first part hereto that this ordinance in all of its parts shall be deemed, taken and treated as part of this contract as though the same were inserted in all proposals, advertisements or bids.

The work shall be commenced on the day of and finished on or before 1st day of Oct., A. D. 1893.

The "Advertisement" hereto prefaced shall be considered as taken and included as part and parcel of this contract, and its provisions shall be of binding force.

IN WITNESS WHEREOF the Chief of the Department of Public Works, by virtue of the authority in him vested for that purpose, on behalf of the party of the first part, and the said parties of the second part, have hereunto set their hands and seals this 15th day of July, A. D. 1893.

Witness:

I. BINGAMAN.

E. M. BIGELOW. [Seal]
Chief Department of Public Works.

BOOTH & FLINN, LIMITED, [Seal]
WM. FLINN,
Chairman.

_____ [Seal]

_____ [Seal]

PROPOSAL
for the
Grading, Repaving and Curbing of N. Highland Ave. from Bryant St. northwardly.

Having examined the Plans and Specifications for the Grading, Paving and Curbing of the said street, in the office of Department of Public Works, and the agreement to be entered into in case of award of contract to us, we do hereby PROPOSE and AGREE to furnish all the Materials, Tools and Labor required to ~~grade,~~ repave and curb the above named N. Highland Ave. between the points men-

tioned in strict accordance with the Plans, Specifications and Instructions of the Chief of the Department of Public Works, or his assistant, the Superintendent of Engineering and Surveys, at the following prices:

Asphalt	~~for~~ ~~Grading,~~	the sum of	$325	per	Cubic	Yard.	No.	3
1590	" Paving, Asphalt		$280√	"	Square	"	"	4
1580	" " B. Stone		$300	"	"	"	"	1
	" " "		$335	"	"	"	"	2
	" " "		$	"	"	"		
	" Curbing, new		$0.70√	"	Lineal	Foot.		
	Ligonier							
790	" Crossing, Granite		$0.70√	"	Square	"		
	~~setting new curb.~~			"Lin		"		
	resetting old curb.		0 20√	"	"	"		

Contractor will state price per sq. yd. for repaving in street. Returns with same material now on the ground.

0.30 per Sq. yard.

We hereby certify that this PROPOSAL is made without any connection with any other person or persons making any bid or proposal for the above work; and no member of Councils or other officer of the city is directly or indirectly interested therein, or any portion of the profits thereof.

Name, BOOTH & FLINN, LIMITED,
WM. FLINN,
Chairman.

Address, ————————

BOND.

KNOW ALL MEN BY THESE PRESENTS, That Booth & Flinn, Ltd., C. H. Stoltzenbach and P. M. Pfeil, of the County of Allegheny and Commonwealth of Pennsylvania, are held and firmly bound unto the City of Pittsburgh in the sum of Ten thousand (10000) Dollars dollars, to be paid to the said City of Pittsburgh, its certain attorney, successors or assigns to which payment well and truly to be made and done, we do bind ourselves, our heirs, executors and administrators, and every of them, jointly and severally, firmly by these presents.

WITNESS our hands and seals, the 25 day of May in the year of our Lord, one thousand eight hundred and ninety three.

WHEREAS, the above bounden Booth & Flinn Ltd. have filed with the Controller of the said City of Pittsburgh, Proposals for the ~~Grading~~ Repaving ~~and Curbing~~ of N. Highland Avenue from Bryant street northwardly, in the said City, to be done under and in pursuance of the Acts of Assembly of the Commonwealth of Pennsylvania authorizing the same, and the Ordinances of the Councils of said City relating thereto: now

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH,

That if the said Booth & Flinn Ltd. shall enter into a written contract with the said City of Pittsburgh as required by said Acts of Assembly and Ordinances, in case the said contract shall be awarded to him or them, and shall well and faithfully keep,

perform and fulfill in all its parts the contract to be made and entered into by and between the said City of Pittsburgh, and the said Booth & Flinn Ltd. for the ~~construction of~~ repaving ~~Sewer on~~ N. Highland avenue from Bryant street northwardly, and the furnishing of all the material therefor in accordance with the aforesaid contract, and shall keep all said work in continuous good repair for the period of five years after the completion and acceptance of the same, and shall from time to time thereafter indemnify the said City of Pittsburgh against all loss, costs and damages which may arise from the non-fulfillment of the contract aforesaid in any manner whatever, or for or by reason of any failure of any kind whatsoever upon the part of the said Booth & Flinn Ltd. contractor to keep and perform fully and faithfully all the terms and conditions therein named and contained, then this obligation to be void, otherwise to be and remain in full force and virtue.

BOOTH & FLINN, LIMITED,
WM. FLINN, (Seal)
Chairman.
———————. (Seal)
C. H. STOLZENBACH. (Seal)
P. M. PFEIL, (Seal)

Sealed and delivered in presence of
GEO. BOOTH.

Commonwealth of Pennsylvania,
County of Allegheny,
City of Pittsburgh,—ss.

On the 25th day of May A. D. 1893, before me

the undersigned authority, personally came C. H. Stolzenbach and P. M. Pfeil, sureties in above and foregoing bond, who being by me severally sworn to depose and say, each for himself, that he is or they are worth the sum of Five thousand (5000) dollars over and above all just debts, legal liabilities, exemptions and encumbrances.

C. H. STOLZENBACH.
P. M. PFEIL.

Sworn and subscribed this 25 day of May A. D. 1893.

G. W. BOOTH,
City Clerk.

No. ———.

Resolved, That the contract awarded by the Department of Public Works May 29, 1893, to Booth & Flinn Ld. for the ~~grading,~~ repaving and curbing of North Highland Ave. from Bryant St. northwardly, at the following prices:

.....	For Grading, ...	the sum of	$.....	per	Cubic Yard.
1590	"	Paving, Asphalt #4	"	$ 2.80	"	Square	"
1580	"	" B. Stone	"	$.....	"	"	"
.....	"	"	"	$.....	"	"	"
.....	"	Curbing new	"	$ .70	"	"	"
.....	"	Curbing old reset	"	$ .20	"	Lineal Foot.	
790	"	Crossing, Granite	"	$ .70	"	Square	"
		Repaving street return	"	$ 30c	"	"	Yd.

Shall be and the same is hereby approved together with the bond attached to said contract.

In Councils June 5th 1893 read three times and passed.

Attest: G. W. BOOTH,
Clerk of Select Council.

Attest: .....,
Clerk of Common Council.

Mayor's Office, ...189..

Approved: .....,
Mayor.

Attest: .....
Mayor's Clerk.

Approved by Mayor June 8th 1893.

C. C. No. 276.

RESOLUTION

Approving Contract
For ~~Grading,~~ Repaving and Curbing
North Highland Ave.

From Bryant St.
~~To~~ Northwardly.
In C C, May 29th 1893.
Referred to Committee on Public Works.

E. J. MARTIN,
Clerk.

In Committee on Public Works, June 2d 1893. Ordered to be returned to Councils with Affirmative recommendation.

E. J. MARTIN,
Clerk.

In C C, June 5th 1893.

Rule suspended, read three times, and finally passed.

E. J. MARTIN,
Clerk.

In S C, June 5th 1893.

Rule suspended, read three times, and finally passed.

G. W. BOOTH,
Clerk.

Presented by

. . . . . .

N. 23.—500–6–7–93.

1893 —809—

#29 E281

CONTRACT

FOR

~~Grading,~~ Repaving and Curbing.
N. Highland Ave.

From Bryant St.
~~To~~ Northwardly.

Awarded to

Booth & Flinn Ltd. Contractor.
Date of Award, May 29/93.
First and Final
Estimate Nov 7/93 $9214.00

[Endorsed]: E–8516. District Court of the United States, District of Oregon. Warren Brothers Company, Complainant, vs. Oskar Huber, Defendant. Plaintiff's Exhibit Contract for Paving North Hiland Avenue, Pittsburgh, Pa. Clarence A. Will-

iams, Notary Public and Special Examiner. My Commission Expires January 19, 1923.

U. S. District Court, District of Oregon. Filed May 15, 1922. G. H. Marsh, Clerk.

Plaintiff's Exhibit No. 32.

PLAINTIFF'S EXHIBIT No. 32—CONTRACT FOR PAVEMENT OF DITHRIDGE STREET, PITTSBURG.

This contract was executed October 27, 1893, between City of Pittsburg and Booth & Flinn, Ltd., and provided for the paving by Booth & Flinn of Dithridge Street, Pittsburg, from Fifth Avenue to Forbes Street.

The provisions of this contract (except for the name and description of the street to be paved) are substantially identical with the provisions of the contract for the paving of North Hiland Avenue, Plaintiff's Exhibit 31 above printed, to which reference is hereby made, except as shown by the following excerpt from said Exhibit 32.

EXCERPT FROM FORM OF AGREEMENT TO BE EXECUTED FOR THE IMPROVEMENT OF DITHRIDGE STREET FROM FIFTH AVENUE TO FORBES STREET, MADE OCTOBER 27, 1893, BETWEEN CITY OF PITTSBURGH AND BOOTH & FLINN, LTD., CONTRACTORS.

PREPARATION OF ROAD-BED FOR ASPHALT PAVEMENT.

No. 3.

All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter (be it earth, rock, or other material) shall then be excavated and removed, to the depth of sixteen and one-half (16½) inches below the top line of the proposed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed, and the space filled with clean gravel or sand and carefully rolled with a steam roller of not less than ten (10) tons weight, so as to make such filling compact and solid. Upon the foundation thus prepared shall be laid a bed of broken stone eight (8) inches in depth when rolled, said stone to be broken that none shall measure more than three (3) inches in any direction nor less than two (2) inches (the stone to be of hard native stone). This layer shall be compactly rolled to the satisfaction of the Superintendent of Engineering and Surveys with a steam roller of not less than ten (10) tons weight. Upon this road-bed so rolled shall be laid a layer of Ligonier granite stone four and one-half (4½) inches in thickness when rolled, poured with hot composition distilled expressly for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices or spaces, thereby making the layer one solid mass, and a

binder consisting of clean broken Ligonier granite stone not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters and properly mixed with hot composition through steam mixer, shall then while hot be spread evenly in such quantity as to be two (2) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition, well heated and thoroughly mixed through steam mixers, shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface of pavement proper. The binding material which is a cement prepared with refined Trinidad Asphaltum and composition of pitch (expressly distilled for the purpose) commercially known as No. 4.

The Asphaltic Vulcanized cement shall be prepared in the following proportions:

Asphalt,	from 28 to 43 parts.
No. 4 Pitch,	" 72 " 57 "

The wearing surface shall be composed of:

Asphalt Cement,	from 14 to 18 parts.
Crushed Ligonier Stone,	" 43 " 41 "
Sharp River Sand,	" 43 " 41 "

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen with openings of one-fourth (¼) inch, and heated in revolving heaters and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder in such quantity, as when

compactly rolled with a steam roller, to be two (2) inches in thickness, the whole making one homogeneous mass.

PREPARATION OF ROAD-BED FOR ASPHALT PAVEMENTS.

No. 4.

All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter (be it earth, rock, or other material) shall then be excavated and removed, to the depth of nine (9) inches below the top line of the proposed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed, and the space filled with clean gravel or sand and carefully rolled with a steam roller of not less than ten (10) tons weight, so as to make such filling compact and solid. Upon the foundation thus prepared shall be laid a bed of broken stone six (6) inches in depth when rolled, said stone to be broken that none shall measure more than three (3) inches in any direction nor less than two (2) inches (the stone to be Ligonier, Granite spalls, or of hard native stone). This layer shall be compactly rolled to the satisfaction of the Superintendent of Engineering and Surveys with a steam roller of not less than ten (10) tons weight. Upon this road-bed when rolled there shall be poured a hot composition distilled expressly for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices or spaces, thereby making the layer one

solid mass, and a binder consisting of clean broken Ligonier granite stone not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters and properly mixed with hot composition through steam mixer, shall then while hot be spread evenly in such quantity as to be one and one-half (1½) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition well heated and thoroughly mixed through steam mixers shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The binding material which is a cement prepared with refined Trinidad Asphaltum and composition of pitch (expressly distilled for the purpose) commercially known as No. 4.

The Asphaltic Vulcanized cement shall be prepared in the following proportions:

Asphalt,	from 28 to 43 parts.
No. 4 Pitch,	" 72 " 57 "

The wearing surface shall be composed of:

Asphalt Cement,	from 14 to 18 parts.
Crushed Ligonier Stone,	" 43 " 41 "
Sharp River Sand,	" 43 " 41 "

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen with openings of one-fourth (¼) inch, and heated in revolving heaters and properly mixed in a steam mixer, shall then be spread, while hot,

evenly upon the binder in such quantity, as when compactly rolled with steam roller, to be one and one-half (1½) inches in thickness, the whole making one homogeneous mass.

PROPOSAL

For The

Grading, Paving and Curbing of Dithridge St. from Fifth Avenue to Forbes Street.

Having examined the Plans and Specifications for the Grading, Paving and Curbing of the said street, in the office of Department of Public Works, and the agreement to be entered into in case of award of contract to us, we do hereby PROPOSE and AGREE to furnish all the Materials, Tools and Labor required to grade, pave and curb the above named Dithridge St. between the points mentioned in strict accordance with the Plans, Specifications and Instructions to the Chief of the Department of Public Works, or his assistant, the Superintendent of Engineering and Surveys, at the following prices:

4400	For	Grading, the sum of	$0.42√	per	Cubic	Yard	
3285	"	Paving, Asphalt	$3.00	"	"	"	" 1
3237	"	" B Stone	$2.50√	"	Square	"	No. 4
	"	Irregular	$1.75	"	"	"	
	"		$	"	"	"	
1900	"	Curbing, the sum of	$0.78√	"	Lineal	Foot	
450	"	Crossing, Granite	$0.80	"	Square	"	

We hereby certify that this PROPOSAL is made without any connection with any other person or persons making any bid or proposal for the above work; and no member of Councils or other officer

of the city is directly or indirectly interested therein, or any portion of the profits thereof.

NAME: ADDRESS,

BOOTH & FLINN, LIMITED,

WM. FLINN (signed)

Chairman.

RESOLVED, That the contract awarded by the Department of Public Works Sept. 11th, 1893 to Booth & Flinn, Ld., for the grading, paving and curbing of Dithridge St. from Fifth Avenue to Forbes St.

at the following Prices:

4400	For	Grading,		the sum of	$ .42 per	Cubic Yard
3285	"	Paving,	Asphalt #4	"	$2.50 "	Square "
1900	"	Curbing		"	$ .78 "	Lineal Foot

Shall be and the same is hereby approved together with the bond attached to said contract.

In Councils October 9, 1893, read three times and passed.

Attest: E. J. MARTIN (Signed)

Clerk of Select Council.

Attest: W. C. GEARING (Signed)

Clerk of Common Council.

Approved by the Mayor October 12th, 1893.

Plaintiff's Exhibit No. 33.

PLAINTIFF'S EXHIBIT No. 33—CONTRACT FOR THE PAVING OF BOND STREET, PITTSBURG.

This contract was executed October 8, 1896, between City of Pittsburg and Booth & Flinn, Ltd., and provided for the paving of Bond Street from

North Hiland Avenue to Wightman's Line, Pittsburg.

The provisions of this contract (except for the name and description of the street to be paved) are substantially identical with the provisions of the contract for the paving of North Hiland Avenue, Plaintiff's Exhibit 31 above printed, to which reference is hereby made, except as shown by the following excerpt from said Exhibit 33.

EXTRACTS FROM AGREEMENT FOR THE IMPROVEMENT OF BOND STREET FROM NORTH HIGHLAND AVENUE TO ROBERT WIGHTMAN'S LINE MADE THE 8th DAY OF OCTOBER, 1896, BETWEEN THE CITY OF PITTSBURGH AND BOOTH & FLINN, LTD., OF PITTSBURGH, CONTRACTORS.

PREPARATION OF ROAD-BED FOR VULCANITE ASPHALT.

PAVEMENT NO. 1.

4. All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter, (be it earth, rock, or other material,) shall then be excavated and removed, to the depth of sixteen and one-half (16½) inches below the top line of the proposed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed, and the space filled with broken stone, gravel or sand. The road-bed shall then be truly

shaped and trimmed to the required cross-section and grade, and rolled to ultimate resistance with a roller weighing not less than ten (10) tons. Such portions of the road-bed not practical for rolling shall be consolidated with hand rollers and tampers. Upon the foundation thus prepared shall be laid a bed of broken stone eight (8) inches in depth when rolled, said stone to be broken that none shall measure more than three (3) inches in any direction (the stone to be Ligonier, or granite spalls, or of hard native stone). This layer shall be compactly rolled to the satisfaction of the Director of the Department of Public Works, with a steam roller of not less than ten (10) tons weight. Upon this road-bed, so rolled, shall be laid a layer of Ligonier granite stone, four and one-half (4½) inches in thickness when rolled, then poured with hot composition, distilled especially for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices or spaces, and a binder, consisting of clean broken Ligonier or granite stone, not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters, and properly mixed with hot composition through steam mixer, shall then, while hot, be spread evenly in such quantity as to be two (2) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition, well heated, and thoroughly mixed through steam mixer, shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The binding material which is a

cement prepared with refined Trinidad Lake Asphaltum and composition of pitch (expressly distilled for the purpose) commercially known as No. 4.

The Asphaltic Vulcanized Cement shall be prepared in the following proportions:

Asphalt .....from 28 to 43 parts
No. 4 Pitch .....from 72 to 57 parts

The wearing surface shall be composed of:

Asphalt Cement .....from 14 to 18 parts
Crushed Ligonier Stone .....from 27 to 29 parts
Sharp River Sand .....from 59 to 53 parts

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen, with openings of one-fourth (¼) inch, and heated in revolving heaters, and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder, in such quantity as when compactly rolled with a steam roller, to be two (2) inches in thickness, the whole making one homogeneous mass.

PREPARATION OF ROAD-BED FOR VULCANITE ASPHALT.

PAVEMENT No. 2.

Preparation of foundation.

5. All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter (be it earth, rock, or other material), shall then be excavated and removed, to the depth of nine (9) inches below the top line of the pro-

posed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed, and the space filled with broken stone, gravel or sand. The road-bed shall then be truly shaped and trimmed to the required cross-section and grade, and rolled to ultimate resistance with a roller weighing not less than ten (10) tons. Such portions of the road-bed not practical for rolling shall be consolidated with hand rollers and tampers. Upon the foundation thus prepared shall be laid a bed of broken stone six (6) inches in depth when rolled, said stone to be broken so that none shall measure more than three (3) inches in any direction, nor less than two (2) inches. (The stone to be Ligonier or granite spalls or hard native stone.) This layer shall be compactly rolled to the satisfaction of the Director of the Department of Public Works, with a steam roller of not less than ten (10) tons weight. Upon this road-bed, when rolled, there shall be poured a hot composition distilled expressly for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices or spaces, and a binder, consisting of clean broken Ligonier or granite stone, not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters, and properly mixed with hot composition through steam mixer, shall then, while hot, be spread evenly in such quantity as to be one and one-half (1½) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition, well

heated and thoroughly mixed through steam mixer, shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The binding material, which is a cement prepared with refined Trinidad Lake Asphaltum and composition of pitch (expressly distilled for the purpose), commercially known as No. 4.

The Asphaltic Vulcanized Cement shall be prepared in the following proportions:

Asphalt .....from 28 to 43 parts
No. 4 Pitch .....from 72 to 57 parts

The wearing surface shall be composed of:

Asphaltic Cement .....from 14 to 18 parts
Crushed Ligonier Stone .....from 27 to 29 parts
Sharp River Sand .....from 59 to 53 parts

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen, with openings of one-fourth (¼) inch, and heated in revolving heaters, and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder, in such quantity as when compactly rolled with steam roller, to be one and one-half (1½) inches in thickness, the whole making one homogeneous mass.

PROPOSAL

For The

Grading, Paving and Curbing of Bond Street from N. Highland Avenue to R. Wightman's Line.

Having examined the Plans and Specifications for the grading Paving and Curbing of the said

street, in the office of Department of Public Works, and the agreement to be entered into in case of award of contract to ——, —— do hereby PROPOSE and AGREE to furnish all the Materials, Tools and Labor required to grade, pave and curb the above named Bond Street between the points mentioned, in strict accordance with the Plans, Specifications and Instructions of the Director of the Department of Public Works, at the following prices:

5576	For	Grading,					the	sum of	$ .30	per cu. yd.
5690	"	Vulcanite	Asphalt	Paving	No. 1		"		2.50	per sq. yd.
"	"	"	"	"	No. 2		"		1.85	"
"	"	Sheet	"	"	No. 3		"		2.04	"
"	"	"	"	"	No. 4		"		2.21	"
"	"	Trinidad Sheet	"	"	No. 5		"		2.19	"
"	"	"	" "	"	No. 6		"		2.17	"
"	"	"	" "	"	No. 7		"		1.87	"
"	"	"	" "	"	No. 8		"		1.87	"
"	"	Sheet	"	"	No. 9		"		1.87	"
5665	"	Block	Stone	Paving	No. 1		"		2.18	"
"	"	"	"	"	No. 2		"		1.98	"
"	"	"	"	"	No. 3		"		2.71	"
"	"	Irregular	Stone						$....	

3400	For	Curbing	the sum of	.64	per lin. ft.
	"	" re-set	"	.18	"
225	"	Granite Crossings	"	.55	per. sq. ft.
	"	" re-laid	"	.08	"
	"	Flagstone Sidewalks	"	$....	"
	"	Artificial "	"	$....	"
	"	Asphalt "	"	$....	"
	"	Brick "	"	$....	per sq. yd.

—— hereby certify that this PROPOSAL is made without any connection with any other person or persons making any bid or proposal for the above work; and no member of Councils or other officer of the city is directly or indirectly interested therein, or any portion of the profits thereof.

Name: BOOTH & FLINN, LTD.

WM. FLINN, (Signed)

Chairman.

Address, ——————

RESOLVED, That the contract awarded by the Department of Public Works August 10th, 1896 to Booth and Flinn Ltd. for the grading, paving and curbing of Bond Street from N. Highland Avenue to R. Wightman's line at the following prices:

5576	For	Grading	the sum of	$ .30	per	cubic	Yard
5690	"	Paving, Asphalt #2	"	1.85	"	Square	"
	"	"	"	$....	"	"	"
	"	"	"	$....	"	"	"
	"	"	"	$....	"	"	"
3400	"	Curbing	"	$ .64	"	Lineal	Foot
	"	Crossing	"	$....	"	Square	"

Shall be and the same is hereby approved together with the bond attached to said contract.

In Councils August 31st, 1896, read three times and passed.

Attest: E. J. MARTIN, (Signed)

Clerk of Select Council.

Attest: W. C. GEARING, (Signed)

Clerk of Common Council.

Approved by the Mayor Sept. 3, 1896.

Plaintiff's Exhibit No. 34.

Complete list of all VULCANITE STREETS, constructed in the City of Pittsburgh, showing the date of construction of each, the specifications under which each street was constructed and the contractor who constructed the street.

The first VULCANITE STREET constructed in the City of Pittsburgh, was Forbes Street, extending from Craig Street to Shady Avenue. This street was constructed in 1874 under the patents of Dr. Filbert of Philadelphia, Pa.

The last contract let for VULCANITE PAVEMENT in the City of Pittsburgh, was Susquehanna Street, extending from Homewood Avenue to Braddock Avenue, in August, 1896, to Booth and Flinn, Contractors. This street was completed in July, 1897.

The last VULCANITE STREET completed in the City of Pittsburgh was Bunker Hill Street, extending from Highland Avenue to Cumberland Street. Completed by Booth and Flinn in August, 1898.

VULCANITE STREETS CONSTRUCTED IN PITTSBURGH.

Street	From	To	Year	Specifications.	Contractor
		1874			
Forbes St.	Craig St.	Shady Ave.	1874	1	
Second Ave.	Elba Crossing	B. & O. R. R.	1874	1	
		1888			
Barton St.	Ellsworth Ave.	Center Ave.	1888	2	Booth & Flinn
Diamond St.	Smithfield St.	Diamond Sq.	1888	2	" "
Diamond Sq.			1888	2	" "
Dithridge St.	Fifth Ave.	Bayard St.	1888	2	" "
Linden Ave.	Penn Ave.	Penna R. R.	1888	2	" "
Montour Way	Sixth Ave.	Seventh Ave.	1888	2	" "
Marchand St.	Shady Ave.	Denniston Ave.	1888	2	" "
McPherson St.	Fifth Ave.	Dallas Ave.	1888	2	" "
Strawberry Ay.	Smithfield St.	Grant St.	1888	2	" "
Simen St.	Fifth Ave.	Dallas Ave.	1888	2	" "
Winebiddle Ave.	Penn Ave.	Liberty St.	1888	2	" "

Street	From	To	Year	Specifications.	Contractor
		1889			
Atwood St.	Fifth Ave.	Boquet St.	1889	2	Neuchatel Asph. Co.
Boquet St.	Frazier St.	Semple St.	1889	2	" "
Church Ay.	Sixth Ave.	Strawberry Ay.	1889	2	" "
Cherry Ay.	Third Ave.	Water St.	1889	2	" "
Corday Ay.	Pearl St.	Cedar St.	1889	2	" "
Eighth St.	Penn Ave.	Liberty St.	1889	2	Booth & Flinn
Freiheits Ay.	Sixth Ave.	Virgin Ay.	1889	2	" "
Mawhinney St.	Forbes St.	Southerly	1889	2	Neuchatel Asph. Co.
Negley Ave.	Hampton St.	Roup St.	1889	2	Booth & Flinn
Oakland Sq.			1889	2	Chas. Chanil
Strawberry Ay.	Smithfield St.	Liberty St.	1889	2	Booth & Flinn
Scott Ay.	Penn Ave.	Duquesne Way	1889	2	" "
State Ay.	Fifth Ave.	Wylie Ave.	1889	2	" "
Slocum Ay.	Penn Ave.	Liberty St.	1889	2	" "
		1890			
Aiken Ave.	Fifth Ave.	Ellsworth Ave.	1890	2	Booth & Flinn
Alder St.	Highland Ave.	Shady Ave.	1890	2	" "

Street	From	To	Year	Specifications.	Contractor
Copeland St.	Ellsworth Ave.	Walnut St.	1890	2	" "
Corday Ay.	Cedar St.	Edmund St.	1890	2	" "
Denniston Ave.	Fifth Ave.	Penn Ave.	1890	2	" "
Ellsworth Ave.	Penn Ave.	Neville St.	1890	2	" "
Highland Ave.	Penn Ave.	Bryant St.	1890	2	" "
Howe St.	Highland Ave.	Denniston Ave.	1890	2	" "
Kirkpatrick St.	Wylie Ave.	Webster Ave.	1890	2	" "
Lilac St.	Ellsworth Ave.	Westminster Pl.	1890	2	" "
Maddock Ay.	Penn. Ave.	Duquesne Way	1890	2	" "
Penn Ave.	Fifth Ave.	City Line	1890	2	" "
Stanton Ave.	Highland Ave.	Heberton St.	1890	2	" "
Stanton Ave.	Highland Ave.	Clearview St.	1890	2	" "
		1891			
Amberson Ave.	Fifth Ave.	Penna R. R.	1891	2	Booth & Flinn
Aiken Ave.	Ellsworth Ave.	Center Ave.	1891	2	" "
Barton St.	Fifth Ave.	Forbes St.	1891	2	" "
Baum St.	Highland Ave.	Mellon's Line	1891	2	" "
Boquet St.	Atwood St.	Bates St.	1891	2	" "
Baum St.	Negley Ave.	Mellon's Line	1891	2	" "

—2—

VULCANITE STREETS CONSTRUCTED IN PITTSBURGH.

Street	From	To	Year	Specifications.	Contractor
Center Ave.	Craig St.	Highland Ave.	1891	2	Booth & Flinn
Cherry Ay.	Fifth Ave.	Liberty St.	1891	2	" "
Diamond St.	Grant St.	Ross St.	1891	2	" "
Euclid Ave.	Center Ave.	Mellon's Line	1891	2	" "
Fifth Ave.	Boquet St.	Eastwardly	1891	2	" "
Garland Ay.	Sixth Ave.	Strawberry Ay.	1891	2	" "
Halket St.	Fifth Ave.	Wilmot St.	1891	2	" "
Howe St.	Aiken Ave.	Highland Ave.	1891	2	" "
Humber Ay.	Erin St.	Kirkpatrick St.	1891	2	" "
Hays St.	Negley Ave.	Westwardly	1891	2	" "
Jumonville St.	Fifth Ave.	Forbes St.	1891	2	" "
Juliet St.	Wilmot St.	Cato St.	1891	2	" "
Luna St.	Park Ave.	Everett St.	1891	2	" "
Margaretta St.	Highland Ave.	Negley Ave.	1891	2	" "
Marchand St.	Denniston Ave.	Festival St.	1891	2	" "
Oak Ay.	Liberty St.	Cherry Ay.	1891	2	" "

Street	From	To	Year	Specifications.	Contractor
Park Ave.	Frankstown Ave.	Shetland St.	1891	2	Booth & Flinn
Roup St.	Fifth Ave.	Negley Ave.	1891	2	" "
Rural St.	Highland Ave.	Negley Ave.	1891	2	" "
Rebecca St.	Friendship Ave.	Liberty Ave.	1891	2	" "
Ross St.	Fifth Ave.	Diamond St.	1891	2	" "
Sheridan St.	Ellsworth Ave.	Penn Ave.	1891	2	" "
Wilmot St.	Boquet St.	Cunliff Run Brg.	1891	2	" "
Westminster St.	Aiken Ave.	Amberson Ave.	1891	2	" "
		1892			
Cherry Ay.	Fifth Ave.	Third Ave.	1892	4	" "
Craig St.	Fifth Ave.	Center Ave.	1892	4	" "
Callowhill St.	Highland Ave.	Mellon St.	1892	4	" "
College Ave.	Howe St.	Fifth Ave.	1892	4	" "
Evans Ay.	Liberty Ave.	Duquesne Way	1892	4	" "
Elgin Ave.	Highland Ave.	Mellon St.	1892	4	" "
Forbes St.	Craft Ave.	St. Pierre St.	1892	3	" "
Fifth Ave.	Wilkins Ave.	Eastwardly	1892	4	" "
Flavel St.	Station St.	Everett St.	1892	4	" "
Greenfield Ave.	Kearcher St.	Wheatland St.	1892	4	" "

Street	From	To	Year	Specifications.	Contractor
Hoeveler St.	Highland Ave.	Collins Ave.	1892	4	Booth & Flinn
Hogg Ay.	Smithfield St.	Cherry Ay.	1892	4	" "
Keatings Ay.	Roberts St.	Divillier St.	1892	4	" "
Linden Ave.	Penn Ave.	Bruce's Line	1892	4	" "
Mayflower St.	Larimer Ave.	Kenesaw Ay.	1892	4	" "
Mellon St.	Callowhill St.	Elgin St.	1892	4	" "
McCully St.	Highland Ave.	Negley Ave.	1892	4	" "
Poplar Ay.	Hickery Ay.	Washington St.	1892	4	" "
Parker St.	College Ave.	O'Hara St.	1892	4	" "
S. Highland Ave.	Penna R. R.	Penn Ave.	1892	4	" "
Thomas St.	Homewood Ave.	Eastwardly	1892	4	" "
Wallingford St.	Neville St.	Morewood Ave.	1892	4	" "
		1893			
Atlantic Ave.	Penn Ave.	Liberty Ave.	1893	4	" "
Alder St.	Highland Ave.	Spahr St.	1893	4	" "
Aurelia St.	Shady Ave.	Denniston St.	1893	4	" "
Broad St.	Negley Ave.	Highland Ave.	1893	4	" "
Baum St.	Negley Ave.	Rebecca St.	1893	4	" "
Beatty St.	Rural St.	Rippey St.	1893	4	" "

VULCANITE STREETS CONSTRUCTED IN PITTSBURGH.

Street	From	To	Year	Specifications.	Contractor
Beatty St.	Stanton Ave.	Hays St.	1893	4	Booth & Flinn
Bluff St.	Marion St.	Westwardly	1893	4	" "
Bayard St.	Neville St.	Morewood St.	1893	4	" "
Cato St.	Juliet St.	McKee Place	1893	4	" "
Claybourne St.	Aiken Ave.	Graham St.	1893	4	" "
Castleman St.	Amberson Ave.	Morewood Ave.	1893	4	" "
Fifth Ave.	Highland Ave.	Denniston Ave.	1893	4	" "
Hamilton Ave.	Fifth Ave.	Homewood Ave.	1893	4	" "
Homewood Ave.	Penn Ave.	Frankstown Ave.	1893	4	" "
Harvard St.	Highland Ave.	Sheridan Ave.	1893	4	" "
Highland Ave.	Bryan St.	Highland Park	1893	4	" "
Homewood Ave.	Penn Ave.	Cemetery Bridge	1893	4	" "
Hamilton Ave.	Homewood Ave.	Old City Line	1893	4	" "
Ivy St.	Ellsworth Ave.	Fifth Ave.	1893	4	" "
Lawn St.	Hamlet St.	Westwardly	1893	4	" "
Lang Ave.	Penn Ave.	Northwardly	1893	4	" "
Lexington Ave.	Penn Ave.	Reynolds St.	1893	4	" "

Street	From	To	Year	Specifications.	Contractor
Meyran Ave.	Forbes St.	Southerly	1893	4	Booth & Flinn
McKee Place	Forbes St.	Ward St.	1893	4	" "
Neville St.	Ellsworth Ave.	Wallingford St.	1893	4	" "
Pacific Ave.	Penn Ave.	Liberty Ave.	1893	4	" "
Summerlea St.	Ellsworth Ave.	Walnut St.	1893	4	" "
Stratford Place			1893	4	" "
Woodlawn Ave.	Forbes St.	Eastwardly	1893	4	" "
Walnut St.	Negley Ave.	Aiken Ave.	1893	4	" "
York Ay.	Louisa St.	Bates St.	1893	4	" "
		1894			
Black St.	Negley Ave.	Westwardly	1924	6	" "
Bunkerhill St.	Highland Ave.	Euclid Ave.	1894	6	" "
Bluff St.	Magee St.	Gist St.	1894	6	" "
Craft Ave.	Fifth Ave.	Southerly	1894	6	" "
Dithridge St.	Bayard St.	Center Ave.	1894	6	" "
Dithridge St.	Fifth Ave.	Forbes St.	1894	6	" "
Fifth Ave.	Penn Ave.	Denniston Ave.	1894	6	" "
Harvard St.	Negley Ave.	Highland Ave.	1894	6	" "

Street	From	To	Year	Specifications.	Contractor
Mayflower St.	Larimer Ave.	Lincoln Ave.	1895	6	Booth & Flinn
Meyran Ave.	Ward St.	Northwardly	1894	6	" "
Neville St.	Ellsworth Ave.	Fifth Ave.	1894	6	" "
Oneida St.	Grandview Ave.	Virginia Ave.	1894	6	" "
Smith St.	Mobile St.	Hazlewood Ave.	1894	6	" "
Sheridan St.	Stanton Ave.	Northwardly	1894	6	" "
South Highland	Fifth Ave.	Alder St.	1894	6	" "
		1895			
Amber St.	Baum St.	Friendship Ave.	1894	6	" "
Atlantic Ave.	Cypress St.	Penna R. R.	1895	6	" "
Bluff St.			1895	6	" "
Boquet St.	Fifth Ave.	Forbes St.	1895	6	" "
Craft Ave.			1895	6	" "
Farragut St.	Stanton Ave.	McCully St.	1895	6	" "
Graham St.	Potter St.	Center Ave.	1895	6	" "
Herdman Ay.	Broad St.	Rural Ave.	1895	6	" "
Heberton St.	Stanton Ave.	Grafton St.	1895	6	" "
Lilac St.	Fifth Ave.	Westminster St.	1895	6	" "
Mathilda St.	Penn Ave.	Friendship Ave.	1895	6	" "

VULCANITE STREETS CONSTRUCTED IN PITTSBURGH.

Street	From	To	Year	Specifications.	Contractor
Mellon St.	Hays St.	Stanton Ave.	1895	6	Booth & Flinn
Mellon St.	McCully St.	Stanton Ave.	1895	6	" "
Meyran Ave.	Fifth Ave.	Forbes St.	1895	6	" "
Noble St.	Potter St.	Claybourne St.	1895	6	" "
Osceola St.	Liberty Ave.	Cypress St.	1895	6	" "
Roup Place	S. Negley Ave.	Fairmount St.	1895	6	" "
Shady Ave.	Fifth Ave.	Penn Ave.	1895	6	" "
Sheridan Ave.	Stanton Ave.	Grafton St.	1895	6	" "
St. Clair St.	Penn Ave.	McCully St.	1895	6	" "
Walnut St.	S. Negley Ave.	S. Highland Ave.	1895	6	" "
Woodworth St.	Atlantic Ave.	Wallace Line.	1895	6	" "
		1896			
Bellefield Ave.	Forbes St.	Center Ave.	1896	6	" "
Bellefonte St.	Ellsworth Ave.	Walnut St.	1896	6	" "
Collins Ave.	Stanton Ave.	Hoeveler St.	1896	6	" "

Street	From	To	Year	Specifications.	Contractor
Edmond St.	Penn Ave.	Friendship Ave.	1896	6	Booth & Flinn
Emerson St.	Fifth Ave.	Walnut St.	1896	6	" "
Evaline St.	Penn Ave.	Liberty Ave.	1896	6	" "
Filbert St.	Walnut St.	Ellsworth Ave.	1896	6	" "
Forbes St.	Shady Ave.	Beechwood Ave.	1896	6	" "
Friendship Ave.	Winebiddle Ave.	Pacific Ave.	1896	6	" "
Friendship Ave.	Negley Ave.	Euclid St.	1896	6	" "
Hickery Ay.	Fountain St.	Webster Ave.	1896	6	" "
Kelly St.	Fifth Ave.	Old City Line.	1896	6	" "
Lang Ave.	Penn Ave.	Homewood Cem.	1896	6	" "
Neville St.	Present Pave.	Center Ave.	1896	6	" "
Pacific Ave.	Penn. Ave.	Dauphin St.	1896	6	" "
Spahr St.	College St.	Ellsworth Ave.	1896	6	" "

Street	To	From	Year	Specifications.	Contractor
		1897			
Beitler St.	Highland Ave.	Shakespeare St.	1897	6	Penn'a Asph. Co.
Bond St.	Highland Ave.	Wightmans Line	1897	6	Booth & Flinn
Collins Ave.	Stanton Ave.	Jackson St.	1897	6	" "
Chislett St.	Ruthledges Prop.	Stanton Ave.	1897	6	Penn'a Asph. Co.
Euclid Ave.	Penn Ave.	Bunkerhill St.	1897	6	Booth & Flinn
East End Ave.	Penn Ave.	Treffingers Prop.	1897	6	" "
Finance St.	Homewood Ave.	Braddock Ave.	1897	6	" "
Juliet St.	Cato St.	Frazier St.	1897	6	Penn'a Asph. Co.
Lowell St.	Frankstown Ave.	Renfrew St.	1897	6	" "
Susquehanna St.	Homewood Ave.	Braddock Ave.	1897	6	Booth & Flinn
St. Clair St.	McCully St.	Bunkerhill St.	1897	6	" "
		1898			
Bunkerhill St.	Highland Ave.	Cumberland St.	1898	6	Booth & Flinn

The following are sections of specifications adopted by the City of Pittsburgh governing the construction of VULCANITE STREETS.

These specifications are from the year 1888 to 1898 and shall be designated as Nos. 1–2–3–4–5–6 and 7.

(1)

Under the patents of Dr. Filbert.

(2)

Specifications used by the City of Pittsburgh from year 1898 to and including 1891.

PREPARATION OF ROAD-BED FOR ASPHALT PAVEMENT.

No. 2.

All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter (be it earth, rock or other material) shall then be excavated and removed, to the depth of sixteen and one-half (16½) inches below the top line of the proposed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed, and the space filled with clean gravel or sand and carefully rolled with a steam roller not less than twelve (12) tons weight, so as to make the filling compact and solid. Upon the foundation thus prepared shall be laid a bed of broken stone eight (8) inches in depth when rolled, said stone to be broken that none shall measure more than two and one-half (2½) inches in any direction nor less

than two (2) inches (the stone to be hard native stone). This layer shall be compactly rolled to the satisfaction of the Superintendent of Engineering and Surveys or his assistant, with a steam roller of not less than twelve (12) tons weight. Upon this road-bed so rolled shall be laid a layer of Ligonier granite stone four and one-half (4½) inches in thickness when rolled poured with hot composition distilled expressly for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices, or spaces, thereby making the layer one solid mass, and a binder consisting of clean broken Ligonier granite stone not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters and properly mixed with hot composition through steam mixer, shall then while hot be spread evenly in such quantity as to be two (2) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand hydraulic cement and composition, well heated and thoroughly mixed through steam mixers, shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The binding material which is a cement prepared with refined Trinidad Asphaltum and composition of pitch (expressly distilled for the purpose) commercially known as No. 4.

The Asphaltic Vulcanized cement shall be prepared in the following proportions:

Asphalt	from 28 to 43 parts
No. 4, Pitch	" 72 " 57 "

The wearing surface shall be composed of:

Asphal Cement	from 14 to 18 parts
Crushed Ligonier Stone	" 43 " 41 "
Sharp River Sand	" 43 " 41 "

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen with openings of one-fourth (¼) inch, and heated in revolving heaters and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder in such quantity, as when compactly rolled with steam roller, to be two (2) inches in thickness, the whole making one homogeneous mass.

(3)

Specifications used by the City of Pittsburgh from year 1892 to and including 1893:

PREPARATION OF ROAD-BED FOR ASPHALT PAVEMENT.

No. 3.

All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter (be it earth, rock or other material) shall then be excavated and removed, to the depth of sixteen and one-half (16½) inches below the top line of the proposed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed, and the space filled with clean gravel or sand and

carefully rolled with a steam roller of not less than ten (10) tons weight, so as to make such filling compact and solid. Upon the foundation thus prepared shall be laid a bed of broken stone eight (8) inches in depth when rolled, said stone to be broken that none shall measure more than three (3) inches in any direction nor less than two (2) inches (the stone to be of hard native stone). This layer shall be compactly rolled to the satisfaction of the Superintendent of Engineering and Surveys, with a steam roller of not less than ten (10) tons weight. Upon this road-bed so rolled shall be laid a layer of Ligonier granite stone four and one-half (4½) inches in thickness when rolled, poured with hot composition distilled expressly for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices or spaces, thereby making the layer one solid mass, and a binder consisting of clean broken Ligonier granite stone not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters and properly mixed with hot composition through steam mixer, shall then while hot be spread evenly in such quantity as to be two (2) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition, well heated and thoroughly mixed through steam mixers, shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The binding material which is a cement prepared with re-

fined Trinidad Asphaltum and composition of pitch (expressly distilled for the purpose) Commercially known as No. 4.

The Asphaltic Vulcanized Cement shall be prepared in the following proportions:

Asphalt ..... from 28 to 43 parts
No. 4 Pitch .....from 72 to 57 parts

The wearing surface shall be composed of:

Asphalt Cement ..... from 14 to 18 parts
Crushed Ligonier Stone .. from 43 to 41 parts
Sharp River Sand ..... from 43 to 41 parts

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen with openings of one-fourth (¼) inch, and heated in revolving heaters and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder in such quantity, as when compactly rolled with a steam roller, to be two (2) inches in thickness, the whole making one homogeneous mass.

(4)

Specifications used by the city of Pittsburgh from year 1892 to and including 1893.

PREPARATION OF ROAD-BED FOR ASPHALT PAVEMENT No. 4.

All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter (be it earth, rock or other material) shall then be excavated and removed, to the depth of nine (9) inches below the top line of the proposed

pavement. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed, and the space filled with clean gravel or sand and carefully rolled with a steam roller of not less than ten (10) tons weight, so as to make such filling compact and solid. Upon the foundation thus prepared shall be laid a bed of broken stone six (6) inches in depth when rolled, said stone to be broken that none shall measure more than three (3) inches in any direction nor less than two (2) inches (the stone to be Ligonier Granite spalls, or of hard native stone). This layer shall be compactly rolled to the satisfaction of the Superintendent of Engineering and Surveys with a steam roller of not less than ten (10) tons weight. Ppon this road-bed when rolled there shall be poured a hot composition distilled expressly for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices or spaces, thereby making the layer one solid mass and a binder consisting of clean broken Ligonier granite stone not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters and properly mixed with a hot composition through steam mixer, shall then while hot be spread evenly in such quantity as to be one and one-half (1½) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition well heated and thoroughly mixed through steam mixers shall then be put upon the binder to bring the surface to perfect grade and

smoothness. Upon this surface will be laid the wearing surface of the pavement proper. The binding material which is a cement prepared with refined Trinidad Asphaltum and composition of pitch (expressly distilled for the purpose) commercially known as No. 4.

The Asphaltic Vulcanized Cement shall be prepared in the following proportions:

Asphalt ..... from 28 to 43 parts
No. 4 Pitch ..... from 72 to 57 parts

The wearing surface shall be composed of:

Asphalt Cement ..... from 15 to 18 parts
Crushed Ligonier Stone ... from 43 to 41 parts
Sharp River Sand ..... from 43 to 41 parts

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen with openings of one-fourth (¼) inch, and heated in revolving heaters and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder in such quantity, as when compactly rolled with steam roller, to be one and one-half (1½) inches in thickness, the whole making one homogeneous mass.

(5)

Specifications used by the City of Pittsburgh from year 1894 to and including 1897.

PREPARATION OF ROAD-BED FOR VULCANITE ASPHALT

Pavement No. 1.

All paving and other stones necessary to be removed shall be taken up and immediately removed

from the line of the work; the sub-soil or other matter (be it earth, rock or other material) shall then be excavated and removed, to the depth of sixteen and one-half (16½) inches below the top line of the proposed pavement. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed and the space filled with broken stone, gravel or sand. The road-bed shall then be truly shaped and trimmed to the required cross section and grade, and rolled to ultimate resistance with a roller weighing not less than ten (10) tons; such portions of the road-bed not practical for rolling shall be consolidated with hand rollers and tampers. Upon the foundation thus prepared shall be laid a bed of broken stone eight (8) inches in depth when rolled, said stone to be broken so that none shall measured more than three (3) inches in any direction, (the stone to be Ligonier, or granite spalls, or hard native stone). This layer shall be compactly rolled to the satisfaction of the Director of the Department of Public Works, with a steam roller of not less than ten (10) tons weight. Upon this road-bed, so rolled shall be laid a layer of Ligonier granite stone four and one-half (4½) inches in thickness when rolled, then poured with hot composition, distilled especially for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices or spaces, and a binder, consisting of clean broken Ligonier or granite stone, not to exceed one and one-half (1½) inches in diameter, well heated through re-

volving heaters, and properly mixed with hot composition through steam mixer, shall then, while hot, be spread evenly in such quantity as to be two (2) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition, well heated and thoroughly mixed through steam mixer, shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The binding material which is a cement prepared with refined Trinidad Lake Asphaltum and composition of pitch (expressly distilled for the purpose) commercially known as No. 4.

The Asphaltic Vulcanized Cement shall be prepared in the following proportions.

Asphalt ..... from 28 to 43 parts
No. 4 Pitch ..... from 72 to 57 parts

The wearing surface shall be composed of:

Asphalt Cement ..... from 14 to 18 parts
Crushed Ligonier Stone ... from 27 to 29 parts
Sharp River Sand ..... from 54 to 57 parts

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen with openings of one-fourth (¼) inch, and heated in revolving heaters, and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder, in such quantity as when compactly rolled with steam roller, to be two (2) inches in thickness, the whole making one homogeneous mass.

(6)

Specifications used by the City of Pittsburgh from year 1894 to and including 1897.

PREPARATION OF ROAD-BED FOR VULCANITE ASPHALT

Pavement No. 2.

All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter (be it earth, rock or other material) shall be excavated and removed, to the depth of nine (9) inches below the top line of the proposed pavement. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed and the space filled with broken stone, gravel or sand. The road-bed shall then be truly shaped and trimmed to the required cross section and grade, and rolled to ultimate resistance with a roller weighing not less than ten (10) tons, such portions of the road-bed not practical for rolling shall be consolidated with hand rollers and tampers. Upon the foundation thus prepared shall be laid a bed of broken stone six (6) inches in depth when rolled, said stone to be broken so that none shall measure more than three (3) inches in any direction, nor less than two (2) inches. (The stone to be Ligonier, or granite spalls, or hard native stone). This layer shall be compactly rolled to the satisfaction of the Director of the Department of Public Works, with a steam roller of not less than ten (10) tons weight. Upon this road-bed when rolled, there shall be poured a hot compo-

sition, distilled expressly for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices or spaces, and a binder, consisting of clean broken Ligonier or granite stone, not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters and properly mixed with hot composition through steam mixer shall then while hot, be spread evenly in such quantity as to be one and one-half inches (1½) in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition, well heated and thoroughly mixed through steam mixer, shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The Binding material which is a cement prepared with refined Trinidad Lake Asphaltum and composition of pitch (expressly distilled for the purpose) commercially known as No. 4.

The Asphaltic Vulcanized Cement shall be prepared in the following proportions:

Asphalt	from	28	to	43 parts
No. 4 Pitch	"	72	"	57 "

The wearing surface shall be composed of:

Asphalt Cement	from	14	to	18 parts
Crushed Ligonier Stone	"	27	"	29 "
Sharp River Sand	"	54	"	57 "

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen with openings of one-fourth (¼) inch and heated in revolving heaters and properly mixed in a steam mixer shall then be spread while hot, evenly upon the binder, in such quantity as when compactly rolled with steam roller, to be one and one-half inches (1½) in thickness, the whole making one homogenous mass.

(7)

Specifications used by the City of Pittsburgh for the year 1897.

VULCANITE.

All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter (be it earth, rock or other material) shall then be excavated and removed, to the depth of nine (9) inches below the top line of the proposed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed, and the space filled with broken stone, gravel or sand. The roadbed shall then be truly shaped and trimmed to the required cross-section and grade, and rolled to ultimate resistance with a roller weighing not less than ten (10) tons. Such portions of the roadbed not practical for rolling shall be consolidated with hand rollers and tampers. Upon the foundation thus prepared shall be laid a bed of broken stone six (6) inches in depth when rolled, said stone to be broken so that none shall measure more than three (3) inches in any direction nor less than two (2)

inches. (The stone to be Ligonier or granite spawls or hard native stone.) This layer shall be compactly rolled to the satisfaction of the Director of the Department of Public Works, with a steam roller of not less than ten (10) tons weight. Upon this roadbed, when rolled, there shall be poured a hot composition distilled expressly for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices or spaces and a binder, consisting of clean broken Ligonier or granite stone, not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters, and properly mixed with hot composition through steam mixer shall then, while hot, be spread evenly in such quantity as to be one and one-half (1½) inches in thickness after having been compactly settled by rolling. A scratch coat of fine sand, hydraulic cement and composition, well heated and thoroughly mixed through steam mixer, shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The binding material, which is a cement prepared with refined Standard Asphaltum and composition of pitch (expressly distilled for the purpose), commercially known as No. 4.

The Asphaltic Vulcanized Cement shall be prepared in the following proportions :

Asphalt ..... from 28 to 43 parts
No. 4 Pitch ..... " 72 " 57 "

The wearing surface shall be composed of:

Asphalt Cement ..... from 14 to 18 parts
Crushed Ligonier Stone " 27 " 29 "
Sharp River Sand .... " 54 " 57 "

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen with openings of one-fourth (¼) inch, and heated in revolving heaters and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder, in such quantity as when compactly rolled with steam roller, to be one and one-half inches in thickness, the whole making one homogeneous mass.

[Endorsed]: E8516. District Court of the United States, District of Oregon. Warren Brothers Company, Complainant, vs. Oskar Huber, Defendant. Plaintiff's Exhibit History of Pittsburgh Vulcanite Streets With Specifications. Clarence A. Williams, Notary Public and Special Examiner. My Commission Expires January 19, 1923.

U. S. District Court, District of Oregon. Filed May 15, 1922. G. H. Marsh, Clerk.

United States District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 35.

United States District Court, Western District of Pennsylvania.

IN EQUITY—No. 37—November Term, 1915.

WARREN BROTHERS COMPANY

vs.

COUNTY OF ALLEGHENY, I. K. CAMPBELL, J. D. O'NEIL and S. J. TOOLE, County Commissioners, and BOOTH & FLINN, LTD.

AFFIDAVIT OF DONALD McNEIL.

State of Pennsylvania,
County of Allegheny,—ss.

Donald McNeil, being duly sworn, deposes and says:

That he is of lawful age, and that he has been actively engaged in engineering work and has been connected with the firm of Edeburn & Cooper from the year 1892 to 1894. That he has been connected with the engineering and construction department of the City of Pittsburgh from the year 1894 to 1896, during which time he was engaged in the surveying and building of the city streets and highways, and that from the year 1896 to 1908, he was a member of the firm of Lippincott & McNeil, Engineers and Surveyors, having charge of all kinds of engineering and construction work, and that from the year 1908 he has been in the contracting business, building streets, road and highways, and that

he is, at present, president of The Donald McNeil Company, a firm doing street and road paving. That he is familiar with all kinds of street and road paving, all kinds of concrete construction and specifications of same, having had practically twenty-three years' experience in this class of work.

That he has read all the affidavits filed in the above-named case.

That he has never, in the twenty-three years of his experience as engineer and contractor, seen any specifications for concrete, or has he ever built any concrete, or seen any other contractor build concrete construction in which the contractor was allowed to use, in the aggregate in concrete construction, any material finer than sharp sand. The aggregate commonly specified in concrete construction is broken stone, gravel, slag, cinders, or other coarse aggregate, mixed with sand, Portland Cement and water. The sand is usually specified and is required to be clean, coarse and hard, free from dust, loam and other injurious matter. It is understood that Portland Cement is a fine powder, which with the addition of water, crystallizes into a hard and rigid matter. The dust is never allowed to enter into a composition of a Portland Cement structure. Should dust be allowed to enter into the mixture, it will have a tendency to deprive the Portland Cement of its cementing qualities, weakening the whole structure and giving it a chalk-like texture.

He has read the affidavit of William Flinn in this case, in which there are numerous quotations from engineering literature and finds that these quota-

tions, with the exception of the last one, do not refer to the construction of pavements containing a bituminous cement as a binder, but refer to the construction of Portland Cement structures, a subject entirely different from the construction of streets and roadways, and having very little, if anything, in common, barring the fact that a layer of concrete has often been used as a foundation for the support of bituminous wearing surface. Not only is the concrete structure different, but it requires different machinery and apparatus to produce them, one utilizing a cement which is mixed with water and sets into a rigid matter, the other requires the aggregate to be heated, all moisture being driven off, and mixed with a bituminous cement. The two masses are entirely dissimilar, one is plastic and yielding with the bitumen in its original condition, while the other, through the setting of the cement and the evaporation of the water necessary for mixing, is hard, rigid and stone-like. In the last quotation from the Encyclopedia Britannica, which describes a road commonly called macadam road, and it states that the stone for the road is broken in uniform sizes, from two to two and one-half inches in size, and contains about fifty-five per cent of solid matter and forty-five per cent of voids. In a well consolidated road, the void is filled by small fragments, detritus and mud, the result of wear.

Deponent further says that he read the statement of William Flinn, on page eight of his affidavit, stating that he has put down, in the City of Pittsburgh, numerous pavements, the mineral ag-

gregate of which ranged from relatively large pieces to dust, that is from particles from two inches to two and one-half inches in its greatest cross section to dust, and the mineral aggregate of these streets possess inherent stability, which was inherent independent of the binder. That some of the streets thus constructed are:

Bellefield Avenue. Forbes Street.
Lang Avenue. Highland Avenue

Affiant states that he has examined the records of the contracts and the specifications under which pavements were built on—

Bellefield Avenue.
St. Marie Street, formerly Bond Street.
North Highland Avenue.
Elgin Avenue.
Lang Avenue.
Forbes Street.

And that he has examined the contract which contains the specifications for North Highland Avenue and St. Marie Street (formerly Bond Street), and finds that the specifications of the wearing surface of Elgin Avenue and North Highland Avenue to be as follows:

"The Asphaltic Vulcanized Cement shall be prepared in the following proportions:

Asphalt from 28 to 43 parts.
No. 4, Pitch " 72 to 57 "

The wearing surface shall be composed of:

Asphalt Cement from 14 to 18 parts.
Crushed Ligonier Stone " 43 to 41 "
Sharp River Sand " 43 to 41 "

With sufficient sulphur, lime and cement to harden the asphaltic cement.

The whole to be screened through a revolving screen with openings of one-fourth (¼) inch, and heated in revolving heaters and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder in such quantity, as when compactly rolled with steam roller, to be one and one-half (1½) inches in thickness, the whole making one homogeneous mass."

He also finds that the specifications for the wearing surface of Bellefield Avenue, St. Marie Street (formerly Bond Street), Forbes Street and Lang Avenue, are as follows:

"The Asphaltic Vulcanized Cement shall be prepared in the following proportions:

Asphalt	from	28 to 43 parts.
No. 4, Pitch	"	72 to 57 "

The wearing surface shall be composed of:

Asphalt Cement	from	14 to 18 parts.
Crushed Ligonier Stone	"	27 to 29 "
Sharp River Sand	"	54 to 57 "

With sufficient sulphur, lime and cement to harden the asphaltic cement.

The whole to be screened through a revolving screen with openings of one-fourth inch (¼) and heated in revolving heaters and properly mixed in a steam mixer shall then be spread, while hot, evenly upon the binder, in such quantity as when compactly rolled with steam roller, to be one and one-half (1½) inches in thickness, the whole making one homogeneous mass."

Affiant further states that he has examined the exhibits filed by the defendant marked "Bellefield Avenue, 1896" and "Bond Street, now St. Marie Street, thirty-six feet east of North Highland Avenue," and that on the twenty-first day of July, 1915, caused the removal of pieces of pavement from a spot adjacent to the one described in the affidavit on St. Marie Street, formerly Bond Street, and that he could not find a spot where a sample was removed on Bellefield Avenue, as designated in the affidavit of Mr. Beck, but did find a spot a few feet further away where a sample has been removed, evidently the sample marked Bellefield Avenue. He caused a sample to be removed from Bellefield Avenue at the west curb of Bellefield Avenue, twenty feet north from Forbes Street.

Affiant further states that he has on the same date, removed a sample from all the streets mentioned in the defendant affidavit, to wit:

No. 1, Bellefield Avenue.
No. 2, St. Marie Street.
No. 3, Elgin Avenue.
No. 4. North Highland Avenue.
No. 5, Lang Avenue.
No. 6, Lang Avenue.
No. 7, Forbes Street.

And on July twenty-fourth, removed a sample from Forbes Street, and that he had these samples sawed and makes them an exhibit of his affidavit marked as follows:

No. 1. "Sample of original Vulcanite Pavement, taken from Bellefield Avenue, twenty feet north of

Forbes Street, at the west curb line of Bellefield Avenue. Sample taken July 21st, 1915, at 12:05 P. M. by A. S. Whitehead, Donald McNeil and H. E. Over."

No. 2. "Sample of Vulcanite Pavement, taken from St. Marie Street, twenty-five feet east of Highland Avenue at the north curb line of St. Marie Street. Sample taken July 21st, 1915, at 1:05 P. M. by A. S. Whitehead, Donald McNeil and H. E. Over."

No. 3. "Sample of Vulcanite Pavement taken from Elgin Avenue twenty-one and one-half feet west of North Highland Avenue, on south curb line of Elgin Avenue. Sample taken July 21st, 1915, at 1:50 P. M. by A. S. Whitehead, Donald McNeil and H. E. Over."

No. 4. "Sample of Vulcanite Pavement taken from North Highland Avenue, at the west curb line, thirty-one feet north of Elgin Avenue. Sample taken July 21, 1915, at 2:05 P. M. by A. S. Whitehead, Donald McNeil and H. E. Over."

No. 5. "Sample of Vulcanite Pavement taken from Lang Avenue, at the west curb line, thirteen feet south of Brashear Street. Sample taken July 21st, 1915, at 2:40 P. M. by A. S. Whitehead, Donald McNeil and H. E. Over."

No. 6. "Sample of Vulcanite Pavement taken from Lang Avenue at east curb line and the north five foot line of Meade Street. Sample taken July 21st, 1915, at 3:00 P. M. by A. S. Whitehead, Donald McNeil and H. E. Over."

No. 7. "Sample of Vulcanite Pavement taken from Forbes Street at south curb line and twenty feet east of Shady Avenue. Sample taken July 24th, 1915, at 3:50 P. M. by H. E. Over, A. L. Linderman and Donald McNeil."

All the sawed samples show that the streets were constructed according to the contracts and specifications, to wit:

That the whole wearing surface composed of bitumen, sand and crushed Ligonier stone, will pass through a revolving screen having openings one-quarter inch in size.

The samples chopped out by defendant on Bellefield Avenue, was taken from a spot about fifteen feet from the North line of Forbes Street, and twelve feet East of the curb line, and from a spot WHERE THE WEARING SURFACE HAD WORN THROUGH UNTIL THE STONE OF THE BINDER COURSE PROTRUDED. This sample does not represent the street as it was laid, nor as it is at the present date, but only shows the street at that particular spot where travel and time has worn through the top surface.

Bellefield Avenue comprises Eleven thousand one hundred ten (11,110) yards of which there are about twenty-five (25) square yards in the condition as represented by the sample filed by the defendant and analyzed as shown in affidavit of William L. Beck and marked "Exhibit No. 1." This sample as shown by the analysis itself contains sixty and one tenth (60.1) per cent material coarser than one fourth (¼) inch and fifty-

two and five tenth (52.5) per cent of material passing one and one-half (1½) inch and retained on a half (½). From this analysis it is obvious that the binder course has been analyzed together with as much of the wearing surface as still adhered to it. It is not a representative sample of the construction as laid under the contract, nor is it even a sample of the condition of the pavement as found to-day, and not according to specifications. To show the condition of the street where the sample was taken, I hereby attach a photograph markd "Exhibit —," taken under my direction on the 26th day of July, 1915.

Deponent further states that the sample he removed from Bellefield Avenue, was taken from a spot near the curb line where there is very little traffic and therefore the best place to show a pavement as originally laid.

The sample taken from old Bond Street, now St. Marie Street, was from a spot adjacent to the spot where the sample was taken by the defendant, one side of the sample removed by the affiant is a cut made by the defendant in removing their sample. An examination of the cut section shows that this street was also constructed in accordance with specifications aforementioned in which all the material of the wearing surface would pass a screen having one-quarter inch opening mesh. In comparing this section with the analysis in affidavit of William L. Beck, it must be obvious that some of the binder course has been alanyzed with the wearing surface and reported as part of

it and that the void test has been made, not with the aggregate of the wearing surface *per se* but of a said surface mixture and part of the binder course.

That a part of the foundation has been analyzed with the surface in making the tests of the Bond Street, now St. Marie Street, pavement, is further corroborated by the widely diverging report of the two analyses. Mr. H. H. Craver and Mr. William L. Beck no doubt both made correct analysis, and the difference being in the specimens they analyzed.

Affiant further states that the construction of the Vulcanized Pavement as described by the above specifications was begun in the City of Pittsburgh in the year 1874 and abandoned by the City of Pittsburgh in the year 1897.

Affiant further states that he is familiar with all of the pavements in the City of Pittsburgh mentioned or named in all of the defendant's affidavits in which they state that the mineral aggregate in the wearing surface of the streets possess inherent stability, which was inherent independent of the binder, but affiant states that none of these pavements so mentioned in the defendant's affidavit possess in the wearing surface, inherent stability, which is inherent independent of the binder course. In fact these pavements without the binder would have little more stability than coarse sand. These streets at present show a wrinkled condition on the surface which shows that the wearing surface has been creeping and therefore has practically no stability.

Affiant further states that The Donald McNeil Company, is a licensee of Warren Brothers Company, with the privilege of manufacturing and laying of paving material under Warren Brothers patents. Also having the right to license other contractors to lay material mixed and manufactured by the Donald McNeil Company, but The Donald McNeil Company is not allowed in their license agreement with Warren Brothers Company, to license other contractors to mix, manufacture and furnish the paving material under Warren Brothers patents.

Affiant further states that on July 1st, 1915, he collected a sample of pavement, then being constructed by Booth & Flinn, Ltd., on the property of the Atlantic Refining Company, adjoining Grant Boulevard, and that he sent this sample to A. E. Schutte, at Boston, Mass., for analysis. Sample shipped as follows:

"Sample shipped in a box 7" X 11" X 18" and marked on both ends, 'Sterling Model M,' and lined with brown paper, and on the top of material there were old engineering magazines."

Sworn to and subscribed before me this —— day of July, 1915.

_____.

In the United States District Court for the Middle District of Pennsylvania.

IN EQUITY.—No. 37.

November Term, 1915.

WARREN BROTHERS COMPANY

vs.

COUNTY OF ALLEGHENY, J. D. O'NEIL, I. K. CAMPBELL, and S. J. TOOLE, County Commissioners, and BOOTH and FLINN, LIMITED.

AFFIDAVIT OF DONALD McNEIL.

"B."

To be used in reply to the counter-affidavits of defendants filed in this case, on the application for preliminary injunction.

State of Pennsylvania,
County of Allegheny,—ss.

Donald McNeil, being duly sworn says that he is of lawful age, a resident of Pittsburgh, County and State aforesaid, and is president of Donald McNeil Company, a New Jersey corporation, doing business in Pittsburgh, Pennsylvania; and that he has made another reply affidavit in this case.

That on July 21st, 1915, he proceeded, in company with A. S. Whitehead, H. E. Over and A. C. Leslie, all of Pittsburgh, to Bellefield Avenue, in the said city, and at a point on said avenue,

just North of and adjoining the West curb line and twenty feet North of the street line of Forbes Street, he removed a portion of the pavement of Bellefield Avenue. At the time said portion was cut from the said pavement he identified the said portion by placing thereon and attaching thereto a tag or label marked,

> "Sample of original Vulcanite pavement taken from Bellefield Avenue, twenty feet North of Forbes Street at the West curb line of Bellefield Avenue. Sample taken July 21st, 1915, at 12:05 P. M. by A. S. Whitehead, Donald McNeil, A. C. Leslie and H. E. Over."

That he then in company with the said above-named three persons on the same day proceeded to St. Marie Street in said city, and removed a portion of the pavement from St. Marie (formerly Bond Street) twenty-five feet East of Highland Avenue at the North curb line of St. Marie Street and at the time of the removal of said portion of pavement he identified it by placing thereon and attaching thereto a tag marked as follows:

> "Sample of Vulcanite Pavement taken from St. Marie Street, twenty-five feet East of Highland Avenue, at the North curb line of St. Marie Street. Sample taken July 21st, 1915, at 1:05 P. M. by A. S. Whitehead, Donald McNeil, A. C. Leslie and H. E. Over."

That he then and on the same day with the said three persons proceeded to Elgin Avenue in said city and removed a portion of the pavement of Elgin Avenue, twenty-one and one-half feet

West of the street line of North Highland Avenue, at the South curb of Elgin Avenue, which portion at the time it was removed, he identified by placing thereon and attaching thereto a tag marked as follows:

> "Sample of Vulcanite pavement taken from Elgin Avenue, twenty-one and one-half feet West of North Highland Avenue on the South curb line of Elgin Avenue. Sample taken July 21st, 1915, at 1:50 P. M. by A. S. Whitehead, Donald McNeil, A. C. Leslie and H. E. Over."

That he then on the same day in company with said three persons proceeded to North Highland Avenue in said city, and removed a piece of pavement from North Highland Avenue at the West Curb line, thirty-one feet North of Elgin Avenue and at the time said piece of pavement was removed identified the same by placing thereon and attaching thereto a tag marked as follows:

> "Sample of Vulcanite pavement taken from North Highland Avenue at the West curb line, thirty-one feet North of Elgin Avenue. Sample taken July 21st, 1915, at 2:05 P. M. by A. S. Whitehead, Donald McNeil, A. C. Leslie and H. E. Over."

That the affiant on the same day did then proceed in company with said three persons to Lang Avenue in said city, and removed a portion of the pavement of Lang Avenue at the West curb line, thirteen feet South of Brashear Street which portion he, at the time it was removed, identified by

placing thereon and attaching thereto a tag upon which was written as follows:

> "Sample of Vulcanite pavement taken from Lang Avenue at the West curb line thirteen feet South of Brashear Street. Sample taken July 21st, 1915, at 2:40 P. M. by A. S. Whitehead, Donald McNeil, A. C. Leslie and H. E. Over."

That he then, on the same day in company with said three persons proceeded to another spot on said Lang Avenue and removed a portion of the pavement of said Avenue at the East curb line and the North five-foot line of Meade Street and at the time said portion was removed identified the same by placing thereon and attaching thereto a tag upon which was inscribed as follows:

> "Sample of Vulcanite pavement taken from Lang Avenue at East curb line and the North five-foot line of Meade Street. Sample taken July 21st, 1915, at 3:00 o'clock P. M. by A. S. Whitehead, Donald McNeil, A. C. Leslie and H. E. Over."

That having removed and identified all of the above specified portions of pavement, he, in company with said three persons conveyed all of the same to the office of Donald McNeil Company, in the Jenkins Arcade Building, in the City of Pittsburgh; that he caused the same to be sawed and produces the same as exhibits with this affidavit, marked with tags as above set forth and also with the corporate seal of Donald McNeil Company imprinted on wax adhering to the sample, and also

numbered respectively 1–2–3–4–5 and 6, the number being imprinted in said wax.

That on July 24th, 1915, in the presence of H. E. Over he broke off a portion of the pavement cut from the Bellefield Avenue, known as Exhibit "1," and in the presence of W. P. Thompson delivered the same to C. E. Betz, a chemist employed by the Pittsburgh Testing Laboratory, with directions to analyze the wearing surface of the same, and the said C. E. Betz in the presence of affiant removed from the binder course the wearing surface of said broken off piece. And subsequently the said C. E. Betz delivered to affiant an analysis which is hereto attached, marked "Exhibit A, wearing surface of Bellefield Avenue."

That the said affiant on the 24th day of July, 1915, in company with A. L. Linderman and H. E. Over proceeded to Forbes Street in the City of Pittsburgh, aforesaid and removed a portion of the pavement of Forbes Street at the South curb and twenty feet East of Shady Avenue, and at the time of the removal of the same identified the portions so removed by placing thereon and attaching thereto a tag marked as follows:

"Sample of Vulcanite pavement taken from Forbes Street at the South curb line and twenty feet East of Shady Avenue. Sample taken July 24th, 1915, at 3:50 P. M. by H. E. Over, A. L. Linderman and Donald McNeil."

Which portion so removed affiant caused to be sawed and conveyed to the offices of the Donald McNeil Company in the Jenkins Arcade Building

aforesaid, and the same is filed as an exhibit in this case, marked as above and with the number "7" and the seal of Donald McNeil Company upon adhering wax thereon.

Sworn to and subscribed before me this —— day of July, 1915.

———————.

PITTSBURGH TESTING LABORATORY,
Seventh and Bedford Avenues,
Pittsburgh, Pa.

INSPECTING AND CONSULTING ENGINEERS AND CHEMISTS.
CHEMICAL DEPARTMENT.

No. 47934.
July 26th, 1915.

ANALYSIS OF—ASPHALT PAVEMENT.

SAMPLE MARKED—Sample of Original Vulcanite Pavement taken from Bellefield Ave., 20 ft. North of Forbes St. at West Curb Line of Bellfield Ave.,—Sample taken July.

RECEIVED FROM—The Donald McNeil Company,
Jenkins, Arcade,
Pittsburgh, Penna.

RECEIVED AT LABORATORY—July 24, 1915.
ORDER No. ———

21st, 1915, at 12:05 P. M. by A. S. Whitehead, Donald McNeil, A. C. Leslie and H. E. Over.

Bitumen	10.4%
Sieve Test on Aggregate:	
Passing 200 mesh	= 6.9%
" 100 " retained on 200	= 6.5%
" 80 " " " 100	= 3.7%

Passing	50	mesh	retained	on	80= 9.6%
"	30	"	"	"	50=21.2%
"	20	"	"	"	30=19.5%
"	10	"	"	"	20=16.4%
"	8	"	"	"	10= 5.6%
"	4	"	"	"	8= 9.4%
			Retained	"	4= 1.2%

PITTSBURGH TESTING LABORATORY,
H. H. CRAVER,
LDR. Chief Chemist.

[Endorsed]: E.—8516. District Court of the United States, District of Oregon. Warren Brothers Company, Complainant, vs. Oskar Huber, Defendant. Plaintiff's Exhibit, Affidavits Donald McNeil Identified by Him as Copies of Affidavits Filed in the Case of Warren Brothers Co. vs. Allegheny County, et al. Clarence A. Williams, Notary Public and Special Examiner. My Commission Expires January 19, 1923.

U. S. District Court, District of Oregon. Filed May 15, 1922. G. H. Marsh, Clerk.

[Endorsed]: United States District Court for the District of Oregon. Filed June 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 36.

[NOTE: Plaintiff's Exhibit No. 36 is a duplicate copy of the second, third, fourth and fifth pages of Plaintiff's Exhibit No. 34.]

Plaintiff's Exhibit No. 39.

OREGON STATE HIGHWAY COMMISSION

Sample No. 8957 County—Jackson
Job—Ashland, Calif., Line Type—Cut (Top)
Date sampled—1/25/22 Date tested—1–30–22
Sp. gr. after compression—2.41 & 2.42 Plant .....
Sp. gr. aggregate on 10—2.75 Sta.—71 + 00
Sp. gr. aggregate passing 10—2.64 Laid—1919 16.A√
% Voids after compression—2.8 2.5 V. M. A.—16.7

	%			
A. C.	6.0			
3–2½				
2½–2			As Thick 2¼ in.	
2–1½				
1½–1¼				
1¼–1				
1–¾				
¾–½	33.3			
½–¼	12.8	46.1	49.0	
¼–10	20.1		44.9	
10–20			6.1	
20–30				
30–40	12.0		100.0	
40–50				55.8
50–80	5.4	42.2		36.4
80–100				20.5
100–200	4.7	5.7		
200	5.7	94.3		
Total	100.0			

W. M. S.

(REMARKS ON OTHER SIDE)

OREGON STATE HIGHWAY COMMISSION

Sample No. 8955 County—Jackson
Job—Ashland, Calif., Line Type—Cut (Top)
Date sampled—1/25/22 Date tested—1–30–22
Sp. gr. after compression—2.42 & 2.41 Plant .....
Sp. gr. aggregate on 10—2.78 Sta.—134 + 70
Sp. gr. aggregate passing 10—2.63 Laid—1919
% Voids after compression—.8 V. M. A.—18.5√

	%		
A. C.	7.6		
3–2½			
2½–2			Av. Thick 2½ in.
2–1½			
1½–1¼			
1¼–1			
1–¾			
¾–½	37.7		
½–¼	8.8	46.5	
¼–10	16.6		50.3
10–20			42.9
20–30			6.8
30–40	11.4		———
40–50			100.0
50–80	6.1	39.6	
80–100		6.3	
100–200	5.5	93.7	
200	6.3		
Total	100.0		

W. M. S.

(REMARKS ON OTHER SIDE)

"D" 20

OREGON STATE HIGHWAY COMMISSION

Sample No.—20 County .....
Job—2.34 Type .....
Date sampled .....Date tested .....
Sp. gr. after compression—2.36 Plant .....
Sp. gr. aggregate on 10—2.51 Sta. .....
Sp. gr. aggregate passing 10—2.53 Ld. .....
% Voids after compression—0.4 V. M. A.....

	%		
A. C.	7.0		De Sales St.
3–2½			
2½–2			
2–1½			
1½–1¼			
1¼–1			
1–¾			Extra
¾–½	3.2	7.6	8.0
½–¼	4.4		89.0
¼–10	28.6		3.0
10–20			
20–30			
30–40	34.8		
40–50			
50–80	13.0	82.6	
80–100			
100–200	6.2		
200	2.8	2.8	
Total	100.0		
	972		

W. M. S.

(REMARKS ON OTHER SIDE)

Cut A
B

OREGON STATE HIGHWAY COMMISSION

Sample No. 10015 County .....
Job—B Type .....
Date sampled—A Date tested .....
Sp. gr. after compression—2.29 Plant .....
Sp. gr. aggregate on 10—2.57 Sta. .....
Sp. gr. aggregate passing 10—2.64 Ld. .....
% Voids after compression—1.7 V. M. A.—18.9

	%		
A. C.	7.8		
3–2½			
2½–2			
2–1½			
1½–1¼			
1¼–1			
1–¾			
¾–½	23.0		
½–¼	5.5	28.5	30.9
¼–10	20.4		
10–20			
20–30			
30–40	25.3		
40–50			
50–80	9.9	59.8	64.8
80–100			
100–200	4.2		
200	3.9	3.9	4.3
Total	100.0		
	961		

1442 Arapahoe St.

Denver, Colo.

W. M. S.

(REMARKS ON OTHER SIDE)

#3

OREGON STATE HIGHWAY COMMISSION

Sample No. 9984 County .....
Job—0–2 Type ..... Creosote
Date sampled .....Date tested ..... Wall
Sp. gr. after compression.....Plant .....
Sp. gr. aggregate on 10—3.33 Sta. .....
Sp. gr. aggregate passing 10—2.72 Ld. .....
% Voids after compression.....V. M. A.....

	%		
A. C.	1.4		
3–2½			A. C. 1.4
2½–2			Rock 60.0
2–1½			Sand 38.6
1½–1¼			
1¼–1			
1–¾			
¾–½	38.2		
½–¼	7.3		# 1 & 2 are fine top
¼–10	14.2	59.7	
10–20			
20–30			#s 3, 4, 5, & 6 are lower Top.
30–40	18.6		
40–50			
50–80	12.3		
80–100		35.3	
100–200	4.4		
200	3.6	3.6	
Total	100.0		
	964		

W. M. S.

(REMARKS ON OTHER SIDE)

#4

OREGON STATE HIGHWAY COMMISSION

Sample No. 9984 County .....
Job—O–2 Type .....
Date sampled .....Date tested .....
Sp. gr. after compression.....Plant .....
Sp. gr. aggregate on 10.....Sta. .....
Sp. gr. aggregate passing 10.....Ld. .....
% Voids after compression.....V. M. A. .....

	%	
A. C.	1.8	
3–2½		
2½–2		
2–1½		
1½–1¼		
1¼–1		
1–¾		
¾–½	41.4	
½–¼	10.1	63.4
¼–10	11.9	
10–20		
20–30		
30–40	15.7	
40–50		31.8
50–80	11.7	
80–100		
100–200	4.4	
200	3.0	3.0
Total	100.0	
		970

W. M. S.

(REMARKS ON OTHER SIDE)

#5

OREGON STATE HIGHWAY COMMISSION

Sample No. 9984 County .....
Job—0–2 Type .....
Date sampled ..... Date tested .....
Sp. gr. after compression..... Plant .....
Sp. gr. aggregate on 10..... Sta. .....
Sp. gr. aggregate passing 10..... Ld. .....
% Voids after compression..... V. M. A. .....

	%	
A. C.	1.3	
3–2½		
2½–2		
2–1½		
1½–1¼		
1¼–1		
1–¾		
¾–½	30.5	
½–¼	8.1	55.2
¼–10	16.6	
10–20		
20–30		
30–40	25.0	
40–50		
50–80	11.9	
80–100		40.5
100–200	3.6	
200	3.0	3.0
Total	100.0	
	970	

W. M. S.

(REMARKS ON OTHER SIDE)

#6

OREGON STATE HIGHWAY COMMISSION

Sample No. 9984 County .....
Job—0–2 Type .....
Date sampled .....Date tested .....
Sp. gr. after compression.....Plant .....
Sp. gr. aggregate on 10.....Sta. .....
Sp. gr. aggregate passing 10.....Ld. .....
% Voids after compression.....V. M. A. .....

	%	
A. C.	1.1	
3–2½		
2½–2		
2–1½		
1½–1¼		
1¼–1		
1–¾		
¾–½	38.2	
½–¼	10.0	61.8
¼–10	13.6	
10–20		
20–30		
30–40	20.1	
40–50		
50–80	10.8	34.2
80–100		
100–200	3.3	
200	2.9	2.9
Total	100.0	

971

W. M. S.

(REMARKS ON OTHER SIDE)

#1 Cut—Top

OREGON STATE HIGHWAY COMMISSION

Sample No. 9983 County—Omaha

Job ..... Type—Dump

Date sampled ..... Date tested .....

Sp. gr. after compression—2.48 Plant .....

Sp. gr. aggregate on 10..... Sta. .....

Sp. gr. aggregate passing 10..... Ld. ....

% Voids after compression..... V. M. A. .....

	%				
A. C.	7.0				
3–2½					
2½–2					
2–1½					
1½–1¼					
1¼–1					
1–¾					
¾–½	21.0			Save	
½–¼	10.8	31.8			
¼–10	16.0		34.2		
10–20					
20–30					
30–40	18.1				
40–50					
50–80	16.1	56.5	60.7		
80–100				7.75	
100–200	6.3		5.1		
200	4.7				
			100.0		
Total	100.0				

953

W. M. S.

(REMARKS ON OTHER SIDE)

#2 Cut—Top.

OREGON STATE HIGHWAY COMMISSION

Sample No. 9983 County—Omaha

Job ..... Type—Dump

Date sampled ..... Date tested .....

Sp. gr. after compression—2.48 Plant .....

Sp. gr. aggregate on 10—3.02 Sta. .....

Sp. gr. aggregate passing 10—2.64 Ld. .....

% Voids after compression—3.9 5.0 V. M. A.—18.2 in finished pave

16.8 by cone

	%			
A. C.	6.0			
3–2½				
2½–2				
2–1½				
1½–1¼				
1¼–1				
1–¾			Save	
¾–½	31.0	40.8		
½–¼	9.8		43.4	
¼–10	13.0			
10–20				
20–30				
30–40	16.1			
40–50			52.9	
50–80	14.8			
80–100		36.7		
100–200	5.8	49.7		
200	3.5		3.7	
Total	100.0		100.0	

965

W. M. S.

(REMARKS ON OTHER SIDE)

#3

OREGON STATE HIGHWAY COMMISSION

Sample No. 9983 County—Omaha .....
Job .....Type—Dump
Date sampled .....Date tested .....
Sp. gr. after compression.....Plant .....
Sp. gr. aggregate on 10.....Sta. .....
Sp. gr. aggregate passing 10.....Ld. .....
% Voids after compression.....V. M. A. .....

	%		
A. C.	6.3		
3–2½			
2½–2			
2–1½			
1½–1¼			
1¼–1			
1–¾			
¾–½	18.6		
½–¼	10.8	29.4	31.4
¼–10	17.4		
10–20			
20–30			
30–40	20.5		
40–50		60.2	64.2
50–80	16.6		
80–100			
100–200	5.7		4.4
200	4.1		
			100.0
Total	100.0		

959

W. M. S.

(REMARKS ON OTHER SIDE)

9983 #4

OREGON STATE HIGHWAY COMMISSION

Sample No. 9983 County—Omaha

Job ..... Type—Dump

Date sampled ..... Date tested .....

Sp. gr. after compression..... Plant .....

Sp. gr. aggregate on 10..... Sta. .....

Sp. gr. aggregate passing 10..... Ld. .....

% Voids after compression..... V. M. A. .....

	%		
A. C.	6.3		
3–2½			
2½–2			
2–1½			
1½–1¼			
1¼–1			
1–¾			
¾–½	21.6		
½–¼	9.5	31.1	33.2
¼–10	16.2		
10–20			
20–30			
30–40	19.0		
40–50			
50–80	16.9	58.2	62.1
80–100			
100–200	6.1		
200	4.4		4.7
Total	100.0		100.0

956

W. M. S.

(REMARKS ON OTHER SIDE)

P

OREGON STATE HIGHWAY COMMISSION

Sample No. 10019 County .....
Job—"P" Type .....
Date sampled ..... Date tested .....
Sp. gr. after compression—2.56–2.57–2.58 Plant .....
Sp. gr. aggregate on 10—2.80 Sta. .....
Sp. gr. aggregate passing 10—2.74 Ld. .....
% Voids after compression—.4 V. M. A.—11.7 √
Top ~~12.2~~

	%		
A. C.	4.6	Washington (Penn Ave.)	
3–2½			
2½–2			
2–1½			
1½–1¼			
1¼–1		100%	Agg.
1–¾		47.9	
¾–½	30.0	48.3	
½–¼	15.7	3.8	
¼–10	24.3		
10–20			
20–30			
30–40	10.3		
40–50			
50–80	6.5		
80–100			
100–200	5.0		
200	3.6		
Total	100.0		

964

W. M. S.

(REMARKS ON OTHER SIDE)

V.

OREGON STATE HIGHWAY COMMISSION

Sample No. 10018 County .....

Job .....Type .....

Date sampled .....Date tested—Vt An

Sp. gr. after compression.....Plant .....

Sp. gr. aggregate on 10—2.54 Sta. .....

Sp. gr. aggregate passing 10—2.60 Ld. .....

% Voids after compression..... V. M. A.—14.1 in cone

	%			
A. C.	6.4	Washington inside layer between		
3–2½		fine top & Rock Base.		(100% Agg.
2½–2				(39.5
2–1½				(51.8
1½–1¼				(8.7
1¼–1		No. Sp. G. on this.		
1–¾		wt. in cone	481.5	
¾–½	25.1	Tare	107.5	
½–¼	11.9		——	2565
¼–10	17.8		374.0 ÷ 170 =	2.205 sp. gr.
10–20				——
20–30				.360
30–40	12.4	54.8		
40–50		—— =	21.55√	14.1% Voids
50–80	8.9	2.54		
80–100		38.8	14.93√	
100–200	9.4	—— =	——	
200	8.1	2.60	36.48	
	——	93.6		
Total	100.0	—— =	2.565√	
	919	36.48		

W. M. S.

(REMARKS ON OTHER SIDE)

#1 Cut—Top.

OREGON STATE HIGHWAY COMMISSION

Sample No. 9985 County—Denver.

Job ..... Type .....

Date sampled ..... Date tested .....

Sp. gr. after compression—2.25 Plant .....

Sp. gr. aggregate on 10..... Sta.—H all sample

Sp. gr. aggregate passing 10..... Ld. .....McGovern

% Voids after compression..... V. M. A. .....

	%			
A. C.	8.1			
3–2½				
2½–2				
2–1½				
1½–1¼			Save above #10	
1¼–1				
1–¾				
¾–½	24.5	31.0		
½–¼	6.5		Below #10	
¼–10	21.4		100% Agg.	
10–20				33.7
20–30			33.7	
30–40	25.2		62.0√	
40–50			4.3√	
50–80	7.6	57.0		
80–100			Denver.	
100–200	2.8			
200	3.9			
Total	100.0			
	961			

W. M. S.

(REMARKS ON OTHER SIDE)

#3

OREGON STATE HIGHWAY COMMISSION

Sample No. 9985 County—Denver.

Job ..... Type .....

Date sampled ..... Date tested .....

Sp. gr. after compression—2.25 Plant—H

Sp. gr. aggregate on 10—2.58 Sta. .....

Sp. gr. aggregate passing 10—2.61 Ld. .....

% Voids after compression..... V. M. A. .....

	%			
A. C.	7.4			
3–2½				
2½–2				
2–1½				
1½–1¼				
1¼–1				
1–¾				
¾–½	31.0			37.7
½–¼	3.9	34.9		
¼–10	19.2		100% Agg.	
10–20			~~57.7~~	37.7
20–30			~~37.7~~	57.7
30–40	23.7		~~4.6~~	4.6
40–50		53.4		
50–80	7.4			
80–100				
100–200	3.1			
200	4.3			
Total	100.0			

957

W. M. S.

(REMARKS ON OTHER SIDE)

#2 Cut—Top

OREGON STATE HIGHWAY COMMISSION

Sample No. 9985 County—Denver.

Job ..... Type .....

Date sampled ..... Date tested .....

Spr. gr. after compression—2.25 Plant—H

Sp. gr. aggregate on 10—2.58 Sta. .....

Sp. gr. aggregate passing 10—2.63 Ld. .....

% Voids after compression..... V. M. A. .....

	%		
A. C.	7.5		
3–2½			
2½–2			
2–1½			Save above #10
1½–1¼			
1¼–1			
1–¾			Below #10
¾–½	23.7		
½–¼	4.5	28.2	
¼–10	22.3		100% Agg. 305
10–20			30.5√
20–30			64.5√
30–40	25.7		5.0√
40–50			Denver
50–80	8.5	59.7	
80–100			
100–200	3.2		
200	4.6		
Total	100.0		

W. M. S.

(REMARKS ON OTHER SIDE)

#4

OREGON STATE HIGHWAY COMMISSION

Sample No. 9985 County—Denver

Job ..... Type .....

Date sampled ..... Date tested .....

Sp. gr. after compression—22.5 Plant—H

Sp. gr. aggregate on 10—2.56 Sta. .....

Sp. gr. aggregate passing 10—2.62 Ld. .....

% Voids after compression..... V. M. A.....

	%				
A. C.	7.9				
3–2½					
2½–2					
2–1½					
1½–1¼					
1¼–1					
1–¾			100% agg.	305	
¾–½	23.7	30.5		3.31	62.0
½–¼	6.8		33.1	30.5	57.7
¼–10	21.2		61.8√	37.7	64.5
10–20			5.1√	33.7	61.8
20–30					
30–40	24.7	56.9		4|135.0	4|246.9
40–50				33.75	61.5
50–80	7.9			61.6	
80–100				4.7	
100–200	3.1				
200	4.7			100.0	
Total	100.0				

953

W. M. S.

(REMARKS ON OTHER SIDE)

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 40.

Portland, Oregon, July 6, 1916.

Lab. Nos. P. L. 169 To 174 Inclusive.

Tests made on Samples of Bitulithic Wearing Surface laid by Warren Construction Company 1915 on Columbia River Highway, Multnomah County are Analyses proof a portion of Samples cut by Multnomah County, Ore. Grand Jury.

Samples received at Laboratory June 2, 1916.

Lab. No. P. L. 169 (Sample No. 1) Taken from Columbia River Highway Section A., Station 155 Plus 17.8 4.7′ Left from Centre.

Lab. No. P. L. 170 (Sample No. 2) Taken from Columbia River Highway Section A., Station 157 Plus 24.9. Centre Cut.

Lab. No. P. L. 171 (Sample No. 4) Taken from Columbia River Highway Section B., Station 169 Plus 67.2, 3 Feet to Right of Centre.

Lab. No. P. L. 172 (Sample No. 5) Taken from Columbia River Highway Section B., 350 Ft. E. of E. End Of Shephard's Dell Bridge, 5 Ft. To Right of Centre.

Lab. No. P. L. 173 (Sample No. 7) Taken from Columbia River Highway Section C. 73.6 Ft. W. Of W. End of Oneonta Bridge, 3 Ft. To Right of Centre.

Lab. No. P. L. 174 (Sample No. 8) Taken from Columbia River Highway Section A., Station 150 Plus 25.4, 4 Ft. To Left of Centre.

The other sections of these samples were divided each into 2 parts to be analyzed respectively by R. S. Dulin, Chemist, Bureau of Standards, Portland, Ore., and Edwards and Lazelle, Commercial Chemists, Portland.

	P. L. 169		P. L. 170		P. L. 171		P. L. 172		P. L. 173		P. L. 174	
Bitumen	8.0%		7.7%		7.4%		7.6%		7.9%		8.2%	
Pass 1½	8.7		9.3		16.8		17.1		10.9		13.3	
" 1	9.6		9.5		10.7		13.0		10.7		4.8	
" ¾	17.1		14.3		10.1		19.1		16.3		12.6	
" ½	18.2	53.6	19.9	53.0	21.1	58.7	14.0	63.2	18.2	56	19.4	50.1
" 4	10.0		11.4		10.3		6.1		8.7		10.3	
" 8	2.7	12.7	3.0	14.4	2.7	13.0	1.6	7.7	2.1	10.8	3.0	13
" 10	7.7		7.6		5.8		6.9		3.5		7.4	
" 20	3.7		3.9		3.4		4.8	1.7	4.1			
" 30	3.2		3.2		2.7		3.0		1.3		3.3	
" 40	2.6		2.3		2.0		2.1		2.4		2.7	
" 50	3.9		3.5		3.1		2.1		10.7		5.4	
" 80	1.6		1.4		1.2		1.1		2.9		1.7	
" 100	4.4	27.1	4.0	25.9	3.6	21.8	3.6	23.6	5.7	28.2	4.9	29.5
" 200	6.6	6.8	6.7	6.7	6.5	6.5	5.5	5.5	4.9	4.9	7.1	7.1
	100.00		100.00		100.00		100.00		100.00		100.00	

Sp. Grav.						
Min. Agg.	2.711	2.693	2.812	2.754	2.704	2.687
Sp. Grav.						
Comp. Mixt.	2.413	2.419	2.498	2.48	2.386	2.397
Voids, % Of						
in Min. Agg.	13.0%	13.9%	13.4%	13.4%	14.6%	14.1%
Thickness Av.	2¼″	2⅜″	2½″	3¼″	2½″	2⅛″

Remarks:—Analysis of above samples and Photographs were submitted to the Grand Jury of Multnomah County, Oregon.

Copies to Boston, Portland, E. L. J. CJ.

SAMPLE #1 (P. L. 169 ACTUAL SIZE)

SAMPLE #2 (P. L. 170 ACTUAL SIZE)

SAMPLE #4 (P. L. 171 ACTUAL SIZE)

SAMPLE #5 (P. L. 172 ACTUAL SIZE)

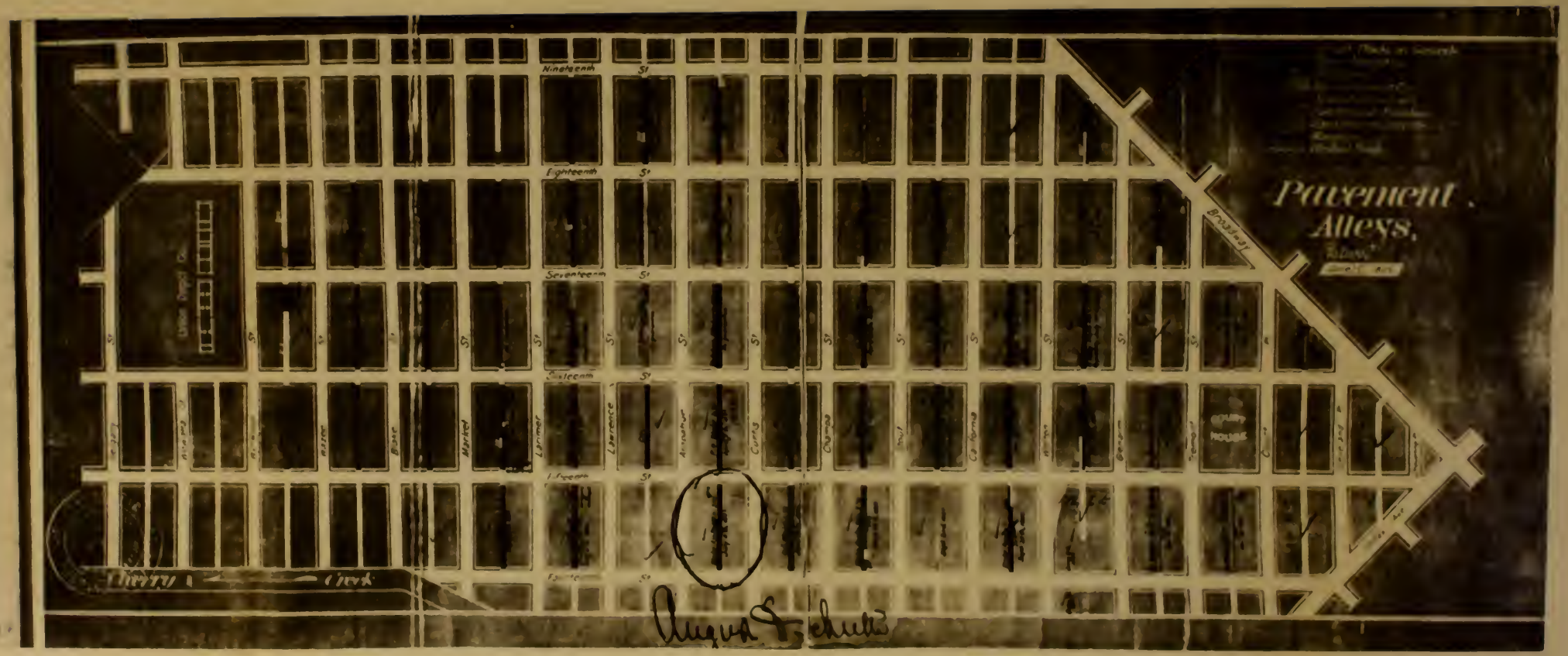
SAMPLE #7 (P. L. 173 ACTUAL SIZE)

SAMPLE #8 (P. L. 174 ACTUAL SIZE)

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

Complainants Exhibit.

Schutte Photographic of Blue Print of Sewer Alleys."



Plaintiff's Exhibit No. 43.

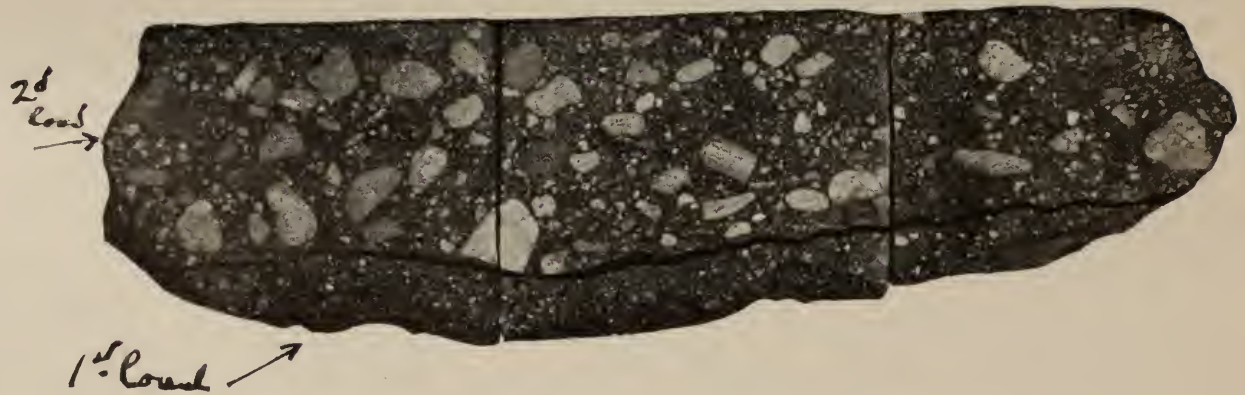
COMPLAINANT'S EXHIBIT — PHOTOGRAPH WEEWATTA STREET, DENVER, COLORADO.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.


Section after cracks with fine sand filled
Sample taken
Asphalt
Asphalt repaired
Butting line
1
2
3
4
5

Plaintiff's Exhibit No. 47.



Complainant's Exhibit Schutte Photograph of Specimen of McGovern Pavement used for Analysis.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 51.

ADVERTISEMENT

Which is to be Included and Considered a Part of this

CONTRACT.

DEPARTMENT OF PUBLIC WORKS.

1893.

TO CONTRACTORS.

SEALED PROPOSALS for the improvement of Dithridge Street from Fifth Avenue to Forbes Street will be received at the office of the City Controller until the 28th day of July at 2 o'clock, P. M.

a. The City of Pittsburgh reserves the right to reject any or all bids, should they deem it for the interest of the City.

b. No contract shall be awarded to any person in arrears to the City, from any cause; or who may have, in former contracts with the City, failed to perform work satisfactory, either in the character of the work or the time unnecessarily consumed in its completion by neglect or wilful delay.

c. The estimated quantities for grading, paving, curbing and otherwise improving Dithridge Street as shown on Letting Plan, No. 189, are to be considered and taken as APPROXIMATE, and the right is expressly reserved by the party of the first part to this agreement, to increase or diminish the said quantities. Nor shall any change of grade alignment, or otherwise vitiate, annul or impair

the contract made and entered into relative to said work, nor constitute any claim for compensation on account of prospective profits. The contractor shall be paid for the amount of work actually performed, at the rates specified in the proposal therefor, and annexed to this contract as part thereof. The full measure of compensation to the contractor to be determined by the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys, whose final estimate of said work shall be conclusive evidence thereof, and of binding force.

d. The prices bid are to cover the furnishing of all materials entering into the construction of the work, and the necessary labor and tools required to perform the work in strict accordance with the plans and specifications of said work.

PROPOSAL

for the

Grading, Paving and Curbing of Dithridge St. from Fifth Avenue to Forbes St.

Having examined the Plans and Specifications for the Grading, Paving and Curbing of the said street, in the office of Department of Public Works, and the agreement to be entered into in case of award of contract to us, We do hereby PROPOSE and AGREE to furnish all the Materials, Tools and Labor required to grade, pave and curb the above named Dithridge St. between the points mentioned in strict accordance with the Plans, Specifications and Instructions of the Chief of the Department of Public Works, or his assistant, the Superintend-

ent of Engineering and Surveys, at the following prices:

4400	For Grading, the sum of	$0.42√	per	Cubic	Yard.	
3285	" Paving, Asphalt	$2.50√	"	Square	"	No. 4
3237	" " B Stone	$3.00	"	"	"	" 1
	" Irregular	$1.75	"	"	"	
	" "	$....	"	"	"	
1900	" Curbing,	$0.78√	"	Lineal	Foot.	
450	" Crossing, Granite	$0.80	"	Square	"	

We hereby certify that this PROPOSAL is made without any connection with any other person or persons making any bid or proposal for the above work; and no member of Councils or other officer of the city is directly or indirectly interested therein, or any portion of the profits thereof.

Name, BOOTH & FLINN, LIMITED,
WM. FLINN,

Chairman.

Address———

FORM OF AGREEMENT,

To be Executed for the Improvement of
Dithridge Street
from Fifth Avenue to Forbes Street.

Made and concluded this 27th day of Oct. A. D. 1893, by and between the City of Pittsburgh, through the Chief of Department of Public Works, duly authorized thereto by an ordinance of the Councils of said City, approved 2d day of March, A. D. 1892, party of the first part, and Booth & Flinn, Ld., of Pittsburgh Pa., Contractors, parties of the second part.

WITNESSETH, That the said parties of the second part have agreed, and by these presents do agree with the said party of the first part, for the consideration hereinafter contained, and under the conditions set forth in a "bond" bearing date July 28th, 1893, and hereunto annexed and made part thereof to furnish, at their own proper cost and expense, all the necessary materials, labor and tools, to grade, pave and curb, in a good and substantial manner Dithridge St. from Fifth Avenue to Forbes Street under the conditions and in compliance with the following

SPECIFICATIONS.

GRADING.

terials, v paid

1. To include all materials on the street, both on roadways and sidewalks. All surplus material to be deposited as the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys may direct. The contractor not to be paid for both excavating and filling, but for whichever contains the greater number of cubic yards. All materials furnished and all the work done, which in the opinion of the Chief of the Department of Public Works, or his assistant the Superintendent of Engineering and Surveys, shall not be in accordance with this specification, shall be immediately removed, and other materials furnished and work done, which shall be in accordance therewith.

e work, w prosected.

2. The work under this agreement is to be prosecuted at and from as many different points in such part or parts of the street, on the line of

work, as the said Superintendent of Engineering and Surveys may from time to time direct.

ight of spension.

3. The right to construct any sewer or sewers, or receiving basins and culverts, or build up or adjust any manholes, or to re-set or renew any frames and heads for sewer manholes in said street, and to grant permits for house connections with sewers, or with water or gas pipes, at any time prior to the laying of the new pavement over the line of the same, is expressly reserved by the said Superintendent (and he expressly reserves the right of suspending the work or any portion thereof, on any part of said line of street or streets, at any time during the construction of the same for the purpose above.)

PREPARATION OF ROAD-BED FOR ASPHALT PAVEMENTS.

NO. 4.

repara- on of undation.

All paving and other stones necessary to be removed shall be taken up and immediately removed from the line of the work; the sub-soil or other matter (be it earth, rock or other material) shall then be excavated and removed, to the depth of nine (9) inches below the top line of the proposed pavements. Should there be any spongy material or vegetable matter in the bed thus prepared, all such material shall be removed, and the space filled with clean gravel or sand and carefully rolled with a steam roller of not less than ten (10) tons weight, so as to make such filling compact and solid. Upon the foundation thus prepared shall be laid a bed of broken stone six (6) inches in depth when rolled,

said stone to be broken that none shall measure more than three (3) inches in any direction nor less than two (2) inches (the stone to be Ligonier, Granite spalls, or of hard native stone). This layer shall be compactly rolled to the satisfaction of the Superintendent of Engineering and Surveys with a steam roller of not less than ten (10) tons weight. Upon this road-bed when rolled there shall be poured a hot composition distilled expressly for the purpose, using not less than one (1) gallon to each square yard, so as to thoroughly permeate all crevices or spaces, thereby making the layer one solid mass, and a binder consisting of clean broken Ligonier granite stone not to exceed one and one-half (1½) inches in diameter, well heated through revolving heaters and properly mixed with hot composition through steam mixer, shall then while hot be spread evenly in such quantity as to be one and one-half (1½) inches in thickness after having been compactly settled by rolling. A scratch coating of fine sand, hydraulic cement and composition well heated and thoroughly mixed through steam mixers shall then be put upon the binder, to bring the surface to perfect grade and smoothness. Upon this surface will be laid the wearing surface or pavement proper. The binding material which is a cement prepared with refined Trinidad Asphaltum and composition of pitch (expressly distilled for the purpose) commercially known as No. 4.

The Asphaltic Vulcanized cement shall be prepared in the following proportions:

Asphalt, from 28 to 43 parts.
No. 4, Pitch, " 72 " 57 "

The wearing surface shall be composed of:

Asphalt Cement, from 28 to 43 parts.
Crushed Ligonier Stone, " 43 " 41 "
Sharp River Sand, " 43 " 41 "

With sufficient Sulphur, Lime and Cement to harden the Asphaltic Cement.

The whole to be screened through a revolving screen with openings of one-fourth (¼) inch, and heated in revolving heaters and properly mixed in a steam mixer, shall then be spread, while hot, evenly upon the binder in such quantity, as when compactly rolled with steam roller, to be one and one-half (1½) inches in thickness, the whole making one homogeneous mass.

CURBING.

Resolved, That the contract awarded by the Department of Public Works Sept. 11th, 1893 to Booth & Flinn Ld. for the grading, paving and curbing of Dithridge St. from Fifth Avenue to Forbes St. at the following prices:

4400	for Grading,	the sum of	$ .42	per	Cubic	Yard.
3285	" Paving, Asphalt #4	"	$2.50	"	Square	"
	" "	"	$	"	"	"
	" "	"	$	"	"	"
	" "	"	$	"	"	"
1900	" Curbing	"	$.78	"	Lineal	Foot.
	" Crossing,	"	$	"	Square	"

Shall be and the same is hereby approved together with the bond attached to said contract.

In Councils October 9th, 1893, read three times and passed.

Attest: E. J. MARTIN,
Clerk of Select Council.

Attest: W. C. GEARING,
Clerk of Common Council.

Mayor's Office ———————— 190 .

Approved ————————,
Mayor.

Attest: ————————,
Mayor's Clerk.

Approved by the Mayor Oct. 12th, 1893.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

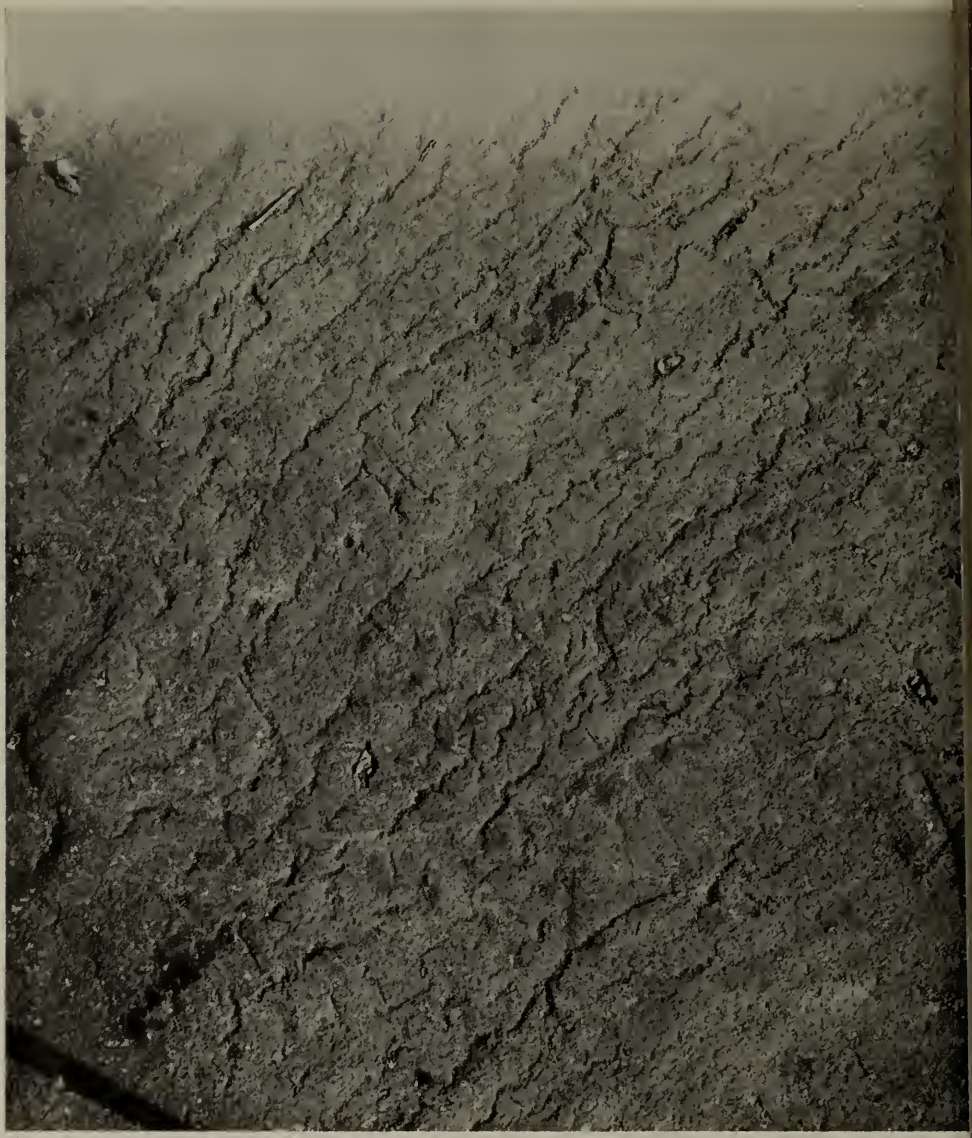
No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Schutte Exhibit No. 2.

Schutte Exhibit No. 3.

Lang Ave., showing soft and typically "wrinkled"

Schutte Exhibit No. 4.



Linden Ave., showing deeply "wrinkled" typical surface. August 10, 1909.

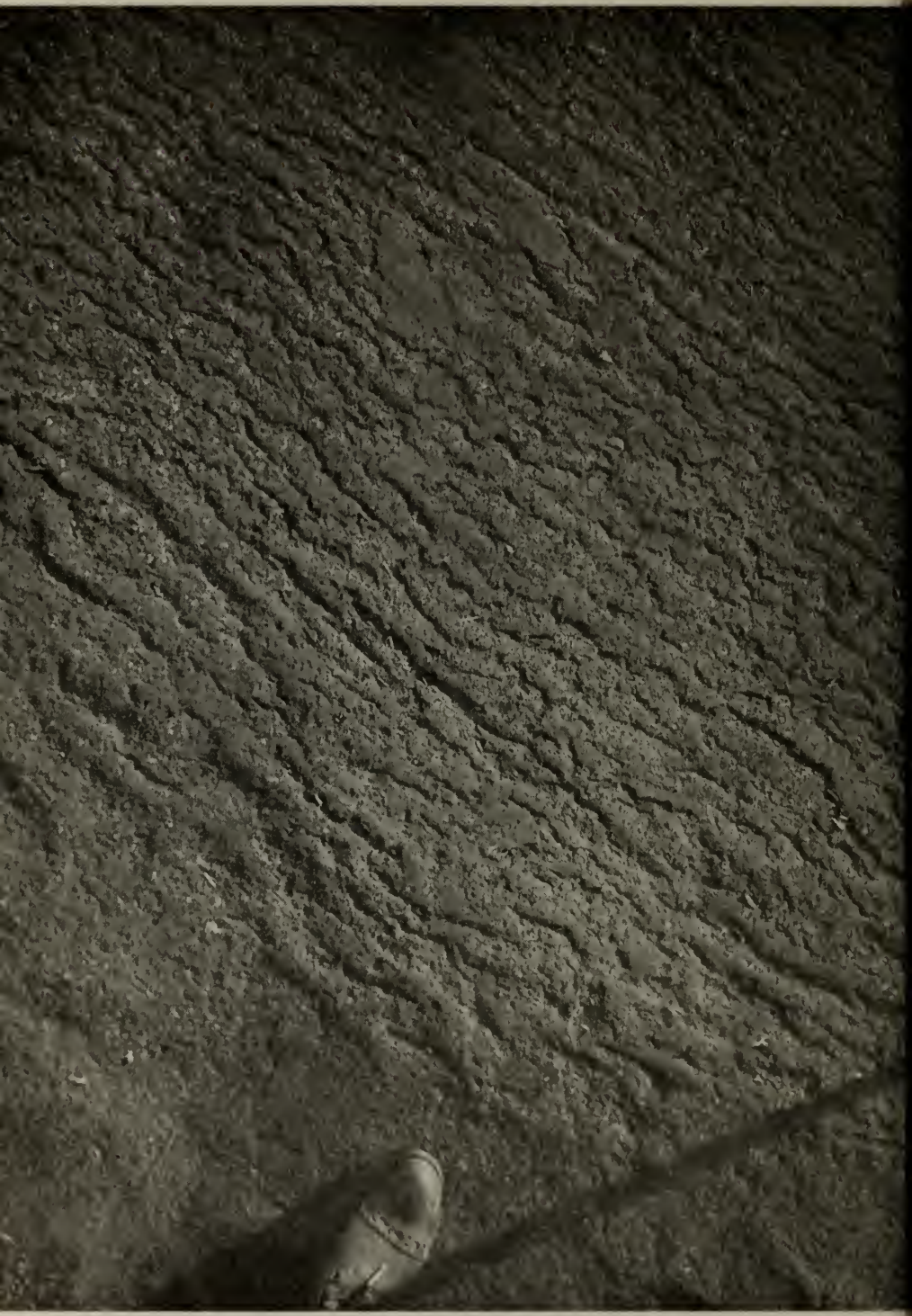
Showing the patched condition of Castleman Street, only about ¼ of the original surface left—showing

Schutte Exhibit No. 6.

224

Schutte Exhibit No. 7.

Schutte Exhibit No. 8.



Schutte Exhibit No. 9.

Ave. Showing spotted condition of street—some hard spots as "A" and some s

A. D. 1884, 12*th February*, No. 3159.

IMPROVEMENTS IN AND RELATING TO MEANS FOR INSULATING AND PROTECTING ELECTRIC WIRES OR CONDUCTORS.

[*Communicated from abroad by William Woods Averell, of Bath, New York, United States of America, late Major-General United States Army.*]

COMPLETE SPECIFICATION.

I William Robert Lake, of the firm of Haseltine, Lake, and Co. Patent Agents, Southampton Buildings, London in the County of Middlesex do hereby declare the nature of said invention for "Improvements in and Relating to means for insulating and protecting electric wires or conductors" and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to means for insulating and protecting electric wires and conductors and comprises an insulating asphaltic-concrete conduit for the reception and protection of electric wires of all descriptions and an improved compound for the said conduit and for insulating electric wires.

A thoroughly practicable system of conduits or pipes for an underground electric system should meet certain requirements, that is to say: The material itself should be of high insulating capacity and of such character as to furnish all necessary protecton to the wires without intervention of other protectors such as metal pipes, or the like.

The conduits should be easy of manufacture and manipulation, economical in first cost; and durable so as to ensure economy of maintenance and repair. Where roadways or streets are to be disturbed in laying the conduit it should be of such character as to create the least disturbance and obstruction during such laying. Where the top of the conduit or system of conduits is at or near the surface of the roadway, it should if practicable, be of such material and manufacture as of itself to form a good and enduring pavement and it should be so constructed as to be affected in the least possible degree by thermal or hygrometric changes.

The objects of this invention are to furnish a material for a system of underground conduits possessing these qualities in the highest degree, and to utilize the same in such a conduit or system of conduits and for the insulation of electric conductors wherever used.

To accomplish this I use an asphaltic concrete, that is a concrete consisting mainly of asphalte or equivalent hydrocarbons and silicious matters. While the proper proportions of these ingredients may be determined in any suitable manner,

to ensure the highest efficiency, it is preferred to ascertain them in the manner hereinafter set forth.

As is well known, both natural asphalt (which herein may be taken as a type of similar hydro-carbons, whether natural or derived from oils or fatty substances) and silica are good insulators, each however having properties which preclude its use alone for this purpose. What I prefer to use is a compound of asphalt and silica.

Silicious particles need some binding agent to unite them in a firm homogeneous mass to prevent movement and saturation which would reduce or destroy the insulative properties of the mass.

Asphalt and other oxigenated hydro-carbons alone are too readily affected by thermal changes, expanding or contracting, or becoming sofe and malleable, or hard and brittle, with changes in temperature.

In view of these facts this invention may be said to consist partly in combining asphalt and silica in such proportions as will furnish only enough cement to fill the interstices of the silicious matter, and thereby render the combination of the two as near a perfect solid as it is possible to attain; partly in the utilization of the matter so prepared as the material from which conduits for underground use are to be made; partly in providing conduits, pipes or tubes for an underground system made as hereinafter set forth from such material, partly in furnishing a matrix holding and protecting tubes of such materials enclosing wires, when it is desired to use such tubes; and partly in insulating electric conductors of all description.

In carrying the said invention into practice what may be called the "voids" of the silicious matter to be used should be accurately ascertained. Suppose two degrees of fineness as regards size of such matter are used (the same principles applying to any number of such degrees) the first being sharp fresh water gravel, well screened, and of a size not larger than a pigeon's egg, and the second ordinary fresh water sand. There are in any given bulk of such material a number of interstices between the points of contact of the units of the mass which, are hereinafter termed "voids."

Starting now with a given bulk of the first element, namely sharp fresh water gravel. The percentage of these "voids" to the entire mass is ascertained in the usual manner by the quantity of water which it will hold, and a proper percentage of fresh water sand is added.

By such experiments the percentage of fine sand which may be mixed with the coarser materials without increasing the bulk may be ascertained for the several varieties used, but there yet will remain "voids" between the units of the mass.

The percentage of these "voids" thus ascertained in volume gives the proportional measure of asphaltic cement (allowance being made for its shrinkage in cooling) which should be added to the silicious matter to form, as nearly as can be done by human agency, a perfect solid, of high insulative capacity, thoroughly waterproof, durable and not affected by thermal or hygrometric changes.

While the above gives a general description of the method of manufacture of the improved asphaltic concrete, I have found it preferable in practice to make some modifications thereof.

When the proportion of sand to be used is ascertained (whether sand alone or in conjunction with the gravel mentioned) I prefer to add to it from five to ten per cent. of ground plaster, or carbonate of lime, of the amorphous kind, in order to partially fill the remaining "voids" to assist in the binding properties of the asphaltic cement by its affinities and to lessen the tendency of the asphaltic cement to contract or expand under thermal changes.

In place of sand a greater or less proportion of pulverized silicious stone or stone dust may be used.

I prefer also not to use the asphalt in its crude or natural state, but to subject it to the action of heat to such a degree that it will resist a high fire test say 208° Fahrenheit.

This eliminates all foreign ingredients, water and the like, and leaves the product a pure, or sufficiently pure asphaltum.

To this mass is then added, while hot say from 15 to 20 per cent. of what is known as the residuum of petroleum, that is liquid bitumen, whose density is 14° to 18° Baumé and which will resist a high fire test.

It follows then that while the asphaltic concrete to be used may be composed of silicious matters and asphaltic cement whose relative proportions are to be ascertained as set forth, the preferable concrete is composed of clean sharp fresh water sand, amorphous carbonate of lime, asphalt and petroleum residuum.

The proportions thereof will vary according to the properties of the materials in any particular locality, and the shrinkage of the cement in passing from a liquid to a solid condition but such proportions can be definitely ascertained by the process hereinbefore described.

These materials are mixed together at a heat which ordinarily should not exceed the lowest degree at which asphaltic cement is maintained in a liquid condition, and the composition is laid or moulded while hot, as hereinafter set forth.

Thus prepared, proportioned, and mixed, a concrete is obtained which, when properly laid, renders the entire conduit solid, so as to prevent the penetration of water, is of high insulative character, comparatively cheap, easy of use, and imperishable by any action of the elements.

In utilizing this concrete for the purpose of an underground electric system, a ditch is dug, upon the bottom of which is laid a foundation of ordinary good hydraulic concrete composed of broken rock, gravel or the like and hydraulic cement to form a firm unyielding base for the layers of insulating concrete to be laid thereon.

Upon such or upon any other suitable base is placed a layer of the improved concrete which is tamped and rammed while hot, it being understood that the sides are supported while the concrete is being compacted.

Upon such layer, wires either naked or insulated, or tubes for the reception of wires are placed.

If wires are used they may be placed thereon from reels which run above the ditch and are so arranged as to lay or reel off the wires, parallel to each other.

If tubes for the reception of wires are to be used, they may be of metal or wooden or paper tubes of proper size laid thereon parallel to each other, or tubes or conduits may be formed by laying upon this (or any other layer) mandrils or formers.

A second layer of the concrete is then placed thereon, rammed and tamped, and other wires or formed tubes are placed upon the said layer.

If the tubes are to be formed of the material *in situ* the forming may be done by the consolidation of the material around the mandrils or formers referred to, which are withdrawn after the hardening or setting of this second or other layer leaving a conduit formed of the concrete itself.

In forming tubes around mandrils or formers, the latter, in order that they may be easily withdrawn after the hardening of the concrete around them, may be oiled or coated with paraffine, or preferably a tube of paper is formed on the mandril or former by winding thereon a sufficient quantity of stiff paper, which may itself have been coated or treated with asphalt. It may be noted that if tubes be used as mandrils they will cool sooner than the surrounding concrete, owing to air passing through them, their subsequent contraction enabling them to be readily withdrawn.

Upon and around such tube the concrete will pack firmly and readily, clinging closely thereto. The interior mandril or former is then withdrawn leaving a conduit or pipe of the concrete lined with paper.

Additional layers are then formed if necessary in the same manner, the result eventually being a prism of solid concrete containing the desired number of wires or tubes for the reception of such wires, either singly or in cables. This concrete prism enclosing the wires is itself of high insulative capacity, economical in first cost, durable, water repellant and of itself, if needed, a good roadway surface.

It need not be laid deep as it will not be affected by thermal or hygrometric changes, and where desired the top layer may itself form the gutter for the roadway or a portion of the roadway itself.

In laying such a conduit or system, it is to be understood, that it may be laid in sections, the sections breaking joint with each other, but the sections of each layer are so laid as to form a continuous homogeneous layer, and the layers united by a flushing of hot asphalt, so as to form a solid continuous homogenous prism enclosing the wires or the tubes for the wires and possessing the qualities before mentioned. Instead of a base of hydraulic concrete, a box of metal or prepared wood or hydraulic concrete may be used the box forming the limits of and aiding in supporting the insulating concrete and wires or tubes, which are laid therein as though upon the hydraulic base. This is preferable where bridges or streams have to be crossed.

In the accompanying drawing

Figure 1 is a perspective view of a prism in a ditch, containing wires and tubes.

Figure 2 is a section thereof laid at the curb or edge of a roadway; while

Figure 3 is a diagram showing large and small tubes enclosed in the prism;

Figure 4 is a view similar to Figure 2, except that the top layer is finished off as part of the roadway.

Figure 5 is a perspective view of a conduit laid in a containing box.

A indicates the side and the bottom of a ditch whose width is that desired for the utimate prism of concrete.

Upon the bottom of this ditch should be laid a foundation B of hydraulic concrete, to afford a firm unyielding bed for the asphaltic concrete.

Upon this base B is laid the first layer C of the asphaltic concrete made as described. It is laid hot and tamped solid before cooling. Preferably, while yet somewhat plastic, wires, as 1, 2, 3, 4, 5, 6, are laid thereon parallel to each other Or cables containing many wires, or single wires having an insulating and protecting covering or naked wires may be laid thereon.

The wires may be easily laid in parallel lines by being unwound from a reel on a carriage whose wheels straddle the ditch, the reel having as many compartments and rolls of wire as there are wires to be laid.

Upon this first layer C is now laid and tamped into place a second layer D. Upon the surface of which tubes *a a* of any suitable configuration in cross section are laid or formed.

It is to be understood that tubes of wires may be placed or formed between any layers, the arrangements shewn in the drawing being merely typical.

The tubes to be embedded may be of any desired material. If they are to be formed or formed and lined say with paper, mandrils or formers are laid in proper position having around them a wrapping of paper as hereinbefore set forth.

The paper tubes thus formed *in situ* are rendered continuous by lapping or passing the end of each over the end of the one in place.

Secured in position a third layer E is placed upon the layer D and thoroughly tamped. This process is repeated until the desired number of layers has been built up.

The joints of the various sections and the lines of union of the layers with each other are made firm and solid by flushing the exposed joints, ends or surfaces with hot liquid asphalte just prior to the addition of the material forming the next section or layer.

The result is a prism of asphaltic concrete, of itself an exceedingly good insulator, thoroughly waterproof, practically indestructible by natural causes and economical in material and labor.

The prism may be placed in any portion of the roadway. In cities especially the more desirable location seems to be at the edge of the roadway, and next the curb, as shewn in Figures 2 and 4 where S indicates the roadway; P the pavement and T the curb, the prism being buried beneath the gutter G.

In Figure 4 a top layer E1 is shewn forming the surface of the prism and finished off to form the gutter for which from its solidity durability and water-proof nature it is well adapted. In fact a top or finishing layer of the prism may well be used as a part of the roadway wherever located.

In Figure 3 is shewn an arrangement typical of the many modifications as to size and distributions of pipes which may be made, there being a large tube H for large cables several smaller ones *h* for smaller cables or collections of wires and small pipes *i i* for one or two wires or small cables.

In Figure 5 is shewn a box B, which may be of metal, wood or composition in which box may be laid the insulating concrete cables, tubes and wires either or all of such form thereof may be desired.

The prism herein represented may be considered a trunk prism or conduit, from which branches may be laid at suitable or desirable points and wires or tubes led off therein from the main prism or conduit.

If desired "man holes" may be made at intervals one end each of two sections or conduits entering therein so as to afford means for ready inspection of the conduits and contents.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed I declare that what I claim is

First. The method of forming an insulating concrete, consisting in first ascertaining the "void" or interstices of the silicious materials used, and then adding a proper percentage of the binding agent thereto, substantially as set forth.

Second. The insulating concrete hereinbefore described, consisting of silicious matter, asphaltum and petroleum residuum combined in the proportions ascertained or determined by the measurement of the interstices or "voids" substantially as set forth.

Third. The insulating concrete hereinbefore described, consisting of silicious matter, asphaltum and petroleum residuum combined substantially as described.

Fourth. An insulating asphaltic concrete conduit formed of silicious materials and tempered asphalt, the percentage of the latter being approximately equal to the ascertained "voids" of the silicious material; and containing wires laid *in situ* substantially as set forth.

Fifth. An insulating asphaltic concrete conduit formed of silicious materials and tempered asphalt, the percentage of the latter being approximately equal to the ascertained "voids" of the silicious materials, and containing tubes, substantially as set forth.

Sixth. An insulating asphaltic concrete conduit formed of silicious materials, and tempered asphalt combined in the proportions set forth, and having its top finished off to form part of the street or roadway substantially as described.

Seventh. An insulating asphaltic concrete conduit formed of silicious materials and tempered asphalt combined in the proportions set forth, and containing pipes or tubes laid and lined with paper *in situ* substantially as set forth.

Dated this 12th day of February, 1884.

HASELTINE, LAKE & CO.,
For the Applicant.

LONDON: Printed by EYRE AND SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.

1884.

FIG. 1.

FIG. 2.

FIG. 3.

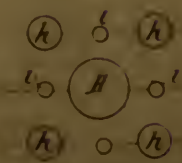
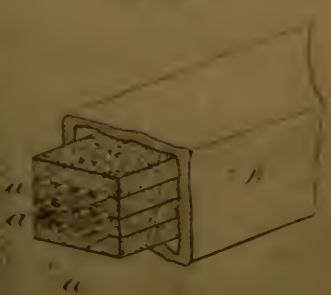


FIG. 4.

FIG. 5



Sp

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1884.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed, Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 55.

New York, Sept. 14, 1900.

Mr. George C. Warren,
Utica, N. Y.

Dear Sir:

HAMILTON TAR PAVEMENTS: As you are probably aware, the City of Hamilton has been doing a considerable amount of this work during the past few years, and they claim that the results are entirely satisfactory to them, and that they are going to continue the work on a rather large scale. We have sold them this year about three thousand barrels of tar, which we prepared specially for them, and which they have found very satisfactory. The work, as we understand it, although we have not the specifications at hand, is simply a tar macadam with some light surface dressing. It has occurred to us that the possibilities of this tar pavement work in small places and on streets of light travel are so great that we wish to have an expert report on the character of the work done in Hamilton, its probable cost, and the condition of their oldest pavements, which we understand to be several years. With this end in view we write to ask if you should feel at liberty to make such an investigation and report for us. If you feel that you could do so without conflicting with the other interests that you represent, we should be glad to have a proposition from you as to the expense of the report and to know

when you could undertake it. Your prompt reply will very much oblige.

Yours very truly,
WARREN CHEMICAL & MFG. CO.,
THOMAS M. RIANHARD.

New York, Sept. 25, 1900.

Mr. George C. Warren,
Hamilton, Ontario.

Dear Sir: PAVEMENT REPORT. We are glad to note from your favor written on the train that you have been able to take this matter up so promptly, and in reply beg to say that the work in question has all been done, so far as we are informed, by the City of Hamilton, Public Works Department, direct, they not only having this work in hand, but a considerable scheme for Portland Cement sidewalks, etc., which they also do with their own men. Our sales have been to the Board of Public Works and have not been for pitch, but for what we call Macadam Brand tar which is practically what we used to call at the Old Long Island City Works, Chemical Tar, that is, tar which has been put through the stills and had removed the water and some of the light oils, giving it a heavy body.

The four points which we want to cover particularly in your report would be as follows:

FIRST: Approximate cost of completed work, with information as to cost of labor and materials entering into construction, methods employed, and could they be improved upon.

SECOND: Age and conditions of streets already completed.

THIRD: Probable life of work done in Hamilton, and whether or not this could be lengthened by improved methods.

FOURTH: Adaptability of this class of work to country roads and light travel streets in this country and Canada and could its use be stimulated with satisfactory results by a system of careful canvassing in a company carefully organized for that class of work.

If there are other subjects bearing on this question which you think it would be useful to cover, please include them.

We may say in this connection that the tar used in this work originates in Boston, and there seems to be some filed for this class of work in New England, that Mr. Runkle may arrange to be in Hamilton on Thursday to look over the work with you.

Yours very truly,

WARREN CHEMICAL & MFG. CO.,
THOMAS P. RIANHARD.

Warren Chemical & Mfg. Co.,

Gentlemen: TAR MACADAM.—As requested I visited Hamilton and spent Friday 28th. inst. there investigating the Tar Macadam there, work done and work being done.

1892 WORK.

The first of this class of work done in this City was laid in 1892 under contract with the Hamilton Gas Co. at ——— per square yard, including guarantee on;—King William Street from James to

John—2 blocks. John Street from King William to Main—1 block.

KING WILLIAM STREET.

This street is about 30 ft. wide. Moderate traffic. No railroad tracks.

The City Engineer, E. B. Wingate, who gave me a good deal of information told me this pavement had had but little repair until 1899 when 7 years old he notified the Gas Co. to put it in repair under their guaranty. They did some work filling holes, etc. in 1899 and this year the Gas Co. made arrangement with the City to resurface the entire street with about 1½ inches of stone coated with tar and finishing surface which I will describe later. The first block (James to Hughson) was in the worst condition and was resurfaced about two months ago and the second block will be resurfaced this fall. The portion to be resurfaced is full of holes and depressions from 2″ to 3″ and some 4″ deep, the depressions holding water which must hasten the decay.

On the portion recently surfaced the surface is scaling and "kneading" under travel but is otherwise in good general condition. A fireman in fire engine house on the street says he thinks the pavement was resurfaced once or twice by the Gas Co. before the present work by the City. The discrepancy between this statement and that of the Engineer may be due to the fact that the latter has been in Hamilton only 2 or 3 years and not personally informed of what has been done.

JOHN STREET.

Under arrangement with the Gas Co. the City Engineer resurfaced this street in June this year but did not use the tarred stone except to fill holes and laid about an inch of the finishing surface. This surface is now soft and "kneading" but otherwise in good general condition. What I refer to as "kneading" is the rolling of the surface in places into this scales over the dirty surface of surrounding pavement which is frequently noticed in repairs to asphalt pavements where mixture used is too rich. When the surface is thus "kneaded" to a thin scale it wears off. Both of these streets were originally laid with horse roller compression.

MARKET SQUARE.

Was also laid in 1892 with about 2″ of tarred stone and finishing surface over an old McAdam pavement. It is not therefore, a full tar McAdam. It is said to have had little repairs until 1899 when it was resurfaced and it now presents a fairly uniform surface.

1899 WORK.

With the exception of the above no work appears to have been done in this line until 1899 when the following streets were laid:

Hughson Street from King William to King	1 block
King St. west from Bay about one mile	1 mile.
King St. east to Wellington about	1 mile.
McNab St. Main to King	1 block.

I did not have time to examine all of this work but I think I examined as much as necessary to get an accurate idea of its condition.

HUGHSON ST. AND McNAB STREET.

As noted above these streets are one block each and were laid in 1899. They are subjected to a medium business traffic. One of the foremen in charge of the tar McAdamining work for the City says that this and other streets laid last year are not as good as they now lay for the reason that they were short of screenings for making the finishing surface and did not use enough of this course. The finishing surface is now nearly all worn off. There are a few depressions worn from 1″ to 2″ deep but the general surface is otherwise good.

1900 WORK.

The streets being laid this year are as follows:

James St. north from Stuart St. to Ferry St. Construction commenced.

James St. (East side only) from Hunter to Aberdeen just completed.

York St. from McNab to Queen nearly completed.

Main St. from McNab to John almost half completed.

East Ave. from King to Stinson recently completed.

Victoria Ave. from Stinson to Baxter recently completed.

Of the above I examined the following:

JAMES STREET, NORTH.

None of the work yet open to traffic but a good deal of the data I give below regarding construction was from notes taken on the work. The street is about 45 ft. wide; double street railroad tracks and will have a fairly heavy business traffic. This street

was previously McAdamized and present work consists of removing about 5″ of old surface and replacing with tarred stone without the usual telford foundation.

JAMES STREET, SOUTH.

One side of this street was paved with asphalt a few years ago and the Tar McAdam was completed a few days ago. The work appeared to me the best I saw. The total width of street is about 46 ft. with double track leaving the strip on one side on which tar McAdam has been laid about 14 ft. The street has a moderate traffic.

MAIN STREET.

One block finished and opened to traffic about one week and balance under construction. The block completed (McNab to James) has no track and the other two blocks have double tracks the McAdam being laid in as well as outside of the tracks. Width about 45 ft. Moderate business traffic. The block completed looks well.

YORK STREET.

This work is about ½ mile long. About 48 ft. wide. Double track, moderate business traffic. One side completed about 10 days ago and the other side about half completed. I walked over about half of the completed side. On the block nearest McNab Street (but laid and completed about 10 days) which is the heaviest travelled and of the street the finishing surface is scaling off and being pulverized into mud by the traffic. Other places show on the surface stones loosened by traffic which

will doubtless soon wear into holes. This may be due to defective rolling or weak foundation from other causes.

CONSTRUCTION.

I enclose copy of the specifications of the City on which I would comment as follows:

ROLLING:

This they do with a 12 ton steam roller such as is usually used for McAdam Roads.

TELFORD FOUNDATION.

In this they first lay flat stone and over this small quarry stone spread on the surface and after spreading the larger particles are broken with napping hammers to about 4″ size. The thickness of this course is about 9″ when spread and it rolls to about 6″ in thickness.

FIRST LAYER TARRED STONE:

The specifications call for stone to pass 2½″ ring. What they are using on the street is hand broken stone, broken during the winter varying in size from 2″ to 4″. I should say that fully half of it would not pass 3″ ring. This course is spread about 3″ thick and is only about half coated with tar. I call attention to the size and half tarring of the stone as this is a condition which would probably not be permitted by a Contractor under these specifications although the work is probably practically as good. The stone is hauled to the street in wagons said to hold one-half cord (64 cu. ft.). I measured two of them and they held about 60 cu. ft. or 2¼ yards. You will note that this is an unusually heavy load. The load of stone is dumped on

a wooden platform on the street similar to a street concrete mixing platform but larger (about 20′ x 10′) and the pile separated into two ridges at each side of the platform and the pile covered with heated tar from a kettle on the street and spread with a dipper. Men then throw the coated stones from the ridges to the center of the board. After a small pile (say ½ yard) is in the center of board the surface of the small pile is coated with tar to cover the uncoated surfaces of the stone. More stone shovelled to the cone shaped pile in the center to a thickness of about 6″ surface then again coated with tar and this operation continued until the whole of the stone is handled to the center of the board. It is then wheeled to the work and spread with rake to a thickness of about 3″. This course is not rolled. A criticism I would make on the score of economy is that they have 8 men shovelling and one man spreading tar on the pile. The men are waiting about half their time for the man to get the pile coated. With two men dipping and spreading the tar they could save from one-third to one-half the cost of mixing but in general the laborers seemed to be working more industriously than is usual on municipal work. The City is now paying 18¢ per hour to laborers, 20¢ to the kettle man and I assumed 30¢ to foreman. Of this course 9 laborers, 1 kettle man, and 1 foreman (cost $2.12 per hour) mixed and laid 3 loads say *say* 7 cu. yds. laying 84 sq. yds. in 3½ hours. Cost of labor mixing and laying being about $1.06 per cu. yd. loose measurement or 9¢ per sq. yd. of bottom course laid.

I can see no reason why this cannot be mixed and laid at as low if not lower labor cost as street concrete is mixed and laid which is from 45¢ to 60¢ a yard = 4¢ to 5¢ sq. yd. 3″ thick.

On one batch which I watched they used 30 dippers or pretty close to 30 gals. tar making cost a 7½¢ per gal. about $2.25 for 2½ cu. yds. or $1.00 per cu. yd. or 8¢ sq. yd. of first layer.

SECOND LAYER:

This is mixed and laid in the same manner as the first layer except that more tar is used and stone thoroughly coated. Thickness 2″. I did not visit the crusher but would say that the stone used in this course has passed a 2½″ ring with all dust and fine material passing ¾″ ring separated out.

From the mixing and laying of one batch (2½ yards) which I watched I took the following notes: Time, 10 men and foremen 40 min.=

⅔ hour cost $1.42

Laid 40 sq. yds. making cost of labor .037 per sq.

Tar used 38 gals. at 7½¢=$2.85=

1.27 cu. yd.= .... .071 " "

The kettle man said they used about 4 bbls. to 5 b. loads stone. Counting the barrels 50 gals. each this figures 40 gals. per load which is pretty close to my estimate above taken from the number of dippers used. If 40 gals. is right it would increase cost of tar to 7½¢ per sq. yd.

This course is thoroughly rolled. You will notice the specifications require the stone to be dry which in wet weather requires heating but

in dry weather screened stone as it comes from a crusher is dry if screened free of dust.

As to thickness of the several courses of tarred stone the thickness specified is when spread before rolling. This is very greatly to the advantage of a contractor as he does not lose the compression which would be ¼ to ⅓ and it removes the possibility of dispute as to thickness of material laid after it has been rolled. The loss of ⅓ in the foundation or telford source, however, should be estimated by a contractor to bring the total thickness of completed work up to the specified 10″.

FINISHING SURFACE:

This consists of fine gravel and crusher screenings, of such size as will pass ¼″ screen heated and mixed with tar being about the same consistency as the surface mixture used in tar walks. In Hamilton the heating and mixing is done by machine at the local asphalt paving company's plant but it can be done by hand and is spread and rolled while hot. It is spread ¾″ thick over the rolled "second layer" and after rolling most of it has been compressed into the voids of the coarse stone of the "second layer" leaving about ¼ on top. Over this after rolling crusher screenings are cast and rolled into the surface. Under traffic the portion of the finishing course which remains on top of the "second layer" is quickly worn off and I think the only practical use of this course which is an important one is the binding

together, the coarser stone below levelling the surface and making a more water tight pavement.

COST.

The City Engineer says that in 1899 the cost was about 80¢ per sq. yd. including excavation with wages 15¢ per hour. This year wages have advanced to 18¢ per hour and cost to about 95¢ per sq. yd. I think this cost must be greater and doubt if their records are kept in such a way as to show the actual cost. I would estimate this cost as follows per sq. yd.:

Excavation say 1 ft. deep usually in crushed stone		.15
TELFORD FOUNDATION:		
½ cu. yd. stone at 1.00 delivered on street	.25	
Labor spreading and breaking	.04	
Rolling	.01	.30
First Layer:		
½ cu. yd. stone at 1.20 delivered on street	.10	
About 1½ gals. tar as previously estimated on street at 7½¢	.08	
Labor as previously estimated	.09	.27
Brot. forward		.72

Brot. forward.....		.72
Second Layer:		
1/18 cu. yd. stone at 1.20.....	.07	
About 14/15 gal. tar as previously estimated at 7½¢	.07	
Labor as previously estimated	.04	
Rolling	.01	.19
Note a difference of 50% in relative cost of labor in the two courses, notes of which were taken on different gauge the one on second layer working perceptibly more industriously than on the first layer, probably the two give a fair average cost.		
FINISHING SURFACE:		
1 cu. yd. screenings and gravel at 75¢ at plant=25¢.....	)	4.85
50 gals. tar at 7½¢ 3.75	)cu.yd.=	
Labor and fuel mixing (probably more than this with hired plant) .60	)48=per sq. yd.	
Handling to street ..... .25	)	10¢
Spreading 1¢. Rolling 1¢. Grit on surface 1¢	.03	.13
Total estimated cost in Hamilton sq. yd.		1.04
Based on the average cost of materials and labor in the U. S. I would estimate the cost about as follows per sq. yd.		
Excavation same as Hamilton..		.15

Telford foundation " " " ...		.30
First Layer:		
1/12 yd. stone on street at 1.50=.....	12½	
1½ gals. tar at .06=.....	06½	
Labor	05	.24
Second Layer:		
1/18 yd. stone at 1.50	08½	
14/15 gal. tar at .06.	05½	
Labor	03	
Rolling	01	.18
Finished surface as estimated for Hamilton	13¢	
Less 1½¢ gal. on tar.....	01½	
	11½ say	.12
Total estimated average cost in U. S. making no allowance for contingent expenses		.99
Add for contingencies 10%		.10
Total cost		$1.09

UTILITY.

I have no doubt but that this tar McAdam is a great improvement over ordinary McAdam and believe it will answer very well in towns or streets where nothing better than a second-class pavement can be afforded. I do not, however, consider that there is anything in Hamilton to yet show that the work will prove to be durable without requiring repairs after the first two or three years except under light traffic. There is nothing to show what the cost would be to keep pavement in good condi-

tion for a term of years under a contract requiring a guaranty but under light traffic I should think the cost of repairs, if made frequently, might be low.

Through a report of the U. S. Consul at Hamilton to the Government at Washington and articles by the engineer, the construction is creating a good deal of attention. The City Engineer told me they have very frequent inquiries by mail and by visiting officials. The reports which they give of cost and durability and the present generally satisfactory condition of the streets will, I have little doubt, result in its extension, perhaps quite largely, in other places and probably it will be laid on streets with entirely too heavy traffic for such a construction. Such was the case with the old McAdam and Nicholson and other pavements which looked well when new and caused the public to go wild over them. I should think it would pay manufacturers who have tar to sell to endeavor to create a demand for the tar for this purpose by encouraging smaller towns to adopt it. By giving tar prepared for this purpose a special brand and making a reputation for the brand it would probably be possible to secure better prices for the tar for this than it brings for the most purposes. All the officials, foremen, and laborers with whom I talked in Hamilton spoke very highly of the tar you have furnished, especially in comparison with tar from Toronto and other places which contained water and bothered by foaming. As far as I could judge the chances seemed to be good for their accepting the option of

taking from you for next year 7,000 bbls. at this year's price, notwithstanding that local parties who are preparing to build large coke ovens in Hamilton are offering to sell their tar at lower price and guarantee it to be as good as yours.

I should think it very doubtful if contracts for any considerable amount of work of this character could be gotten at prices which would make it an attractive business for investment. The reports of cost from Hamilton are very low and will probably give cities an idea that is about what they should pay and the competition would soon be such as to probably leave but little profit to a contractor. I would not advise taking a contract at a price which could probably be gotten under specifications requiring a long guaranty which would be very apt to be required. Please be very careful to see that this report is treated for your information only and not used publicly in any way.

Hoping that this will give you the required information, I remain,

Very truly yours,

GEO. C. WARREN.

Utica, N. Y., Oct. 5, 1900.

United States of America,
District of Oregon,—ss.

I, G. H. Marsh, Clerk of the United States District Court for the District of Oregon, do hereby certify that the foregoing copy of Plaintiff's Exhibit No. 55 in cause E–8516, Warren Brothers Co. vs. Oscar Huber, has been by me compared with the original thereof, and that it is a correct transcript

therefrom, and of the whole of such original, as the same appears of record at my office and in my custody.

In testimony whereof I have hereunto set my hand and affixed the seal of said court at Portland, in said District, this 7th day of June, 1922.

[Seal] G. H. MARSH,
Clerk.
By F. L. Buck,
Deputy Clerk.

[Endorsed]: No. E–8516. In the District Court of the United States for the District of Oregon. Warren Brothers Company vs. Oscar Huber. Certified Copy of Plaintiff's Exhibit No. 55.

HAMILTON CITY CORPORATION.
Board of Works Department.
SPECIFICATIONS FOR TAR MACADAM ROADWAYS.

EXCAVATION.

All earth or other material above the sub-grade shall be excavated, so as to conform to the level of the sub-grade, which will be ten inches below the finished surface of the roadway; and should the sub-grade be above the level of the natural ground, then earth shall be deposited until the level of the sub-grade is reached. The sub-grade shall be shaped to the profile and cross section which will be furnished by the City Engineer.

ROLLING.

After the sub-grade has been formed to the proper camber of the road, generally ½ inch per foot or

six inches for 24 foot roadway, to be thoroughly rolled with the steam road roller, and if by this means soft spots are revealed, they shall be filled with good solid material.

SIZE OF STONE.

The first six inches shall be made in the ordinary way for a Macadam or Telford roadway thoroughly rolled. If so required, it may be made of hard broken stone, furnace clinkers, or brick rolled smooth and finished to the required camber of the road. Upon this shall be placed the tarred stone. The first layer—three inches of hand broken stone to pass through a 2½ inch ring, then a two inch layer of machine broken stone, the whole smoothed off with a hand roller and after top dressing is applied thoroughly rolled with a steam roller. On this a layer composed of fine gravel and quarry chippings, mixed in equal proportions, three-quarter inches thick, shall be placed, and well rolled in so as to fill all interstices. Before finishing, a dressing of stone screenings for the purpose of coloring shall be scattered broadcast to be worked in by the traffic. All layers, including the coloring layer, shall be thoroughly compacted by rolling.

METHOD OF MIXING TAR.

The stone to be tarred shall if moist be heated on an iron floor, under which are flues from a fire, until the moisture is driven out. The material in its heated state is then to be thoroughly mixed with a sufficient quantity of tar. The broken stone in warm weather may be sun dried but in all cases the finer course must be artificially dried. At the same

time care must also be taken not to get this material too hot. The tar should be boiled in iron kettles holding one hundred imperial gallons. Eight imperial gallons should be added to each cubic yard of the coarser material or more if required to completely cover the stone, and seventeen to eighteen gallons to the finer kinds of stone.

TAR.

The tar must be pure Coal Tar free from all foreign substances and containing not more than 5 per cent of water and shall contain upon analysis not less than 55 per cent pitch.

WEATHER.

The work must be done in the summer months, and all work must be suspended during wet weather.

E. B. WINGATE,
City Engineer.

City Engineer's Office, Hamilton, August, 1900.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 56.

TAR-MACADAM ROADWAYS.

A report on the subject, written by Mr. Heddle, Assistant City Engineer, is printed in this report, which fully explains the subject. This class of pavement is not suitable to be used on streets having street-car tracks, but does well on residential streets and on streets of moderate traffic. The

price in the past, as on Hughson Street, between King and King William Streets, which has now been down four years and is still in good order, was 68 cents a yard. Trinidad Asphalt cost $2.10 to $2.60 a yard. We have studied the Tar-Macadam pavements somewhat, and I still believe the plan of grading the stone in layers is better than that of mixing them in a heterogeneous mass, as I understand is done by some cities.

It is stipulated that the foregoing typewritten copy is a correct copy of Plaintiff's Exhibit 56, offered and received in evidence in the case of Warren Brothers Company vs. Oskar Huber, and referred to in the transcript of appeal and said typewritten copy may be used with as full force and effect as the photographic copy thereof stipulated to be substituted for the original.

RICHARD W. MONTAGUE,
Of Attorneys for Appellee.
L. A. LILJEQVIST,
Attorney for Appellant.

[Endorsed]: No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Dec. 31, 1923. F. D. Monckton, Clerk.

Plaintiff's Exhibit No. 58.

[Endorsed]: U. S. District Court, District of Oregon. Filed June 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

TABULATION OF ANALYSES

of

Eight (8) Samples of Bitulithic Mixture from ASHLAND–GREEN SPRINGS MOUNTAIN ROAD SECTION OF PACIFIC HIGHWAY, JACKSON COUNTY, OREGON, Laid by Oskar Huber in 1920—Up to and Including May 4, 1920.

WARREN BROTHERS COMPANY, PORTLAND LABORATORY.

Form 89-113-2,000

State Oregon

City Jackson Co.

Street Pacific Highway 1920

Date										
Lab. No.										
B. C.— D										
L										
21 flux										
24										
55										
B										
Surface Bit. Plant Hydr.										
Lab. "										
" *Dow										
" *Cg										
P. C. Bit. Pen. Hydr.										
" *Dow										
" *Cg										
Bin 6										
5										
4										
3										
2										
1										
Dust										
B. C.—										
Bitumen %	6.5	6.7	6.8	6.6	6.7	6.5	7.0	6.5	6.6	
Pass 1½" %	5.7	8.2		9.1		9.2			2.1	
Pass ¾" %	14.6		14.1	8.2	13.1	7.0	5.6	14.1	9.7	
1" %	7.3	12.8	16.1	15.9	12.8	12.4	11.0	13.4	13.1	
½" %	16.5	14.9	10.1	21.3	11.0	14.9	16.6	15.6	14.2	
¼" %	10.2	23.9	19.8	12.8	10.0	19.6	15.9	16.1	15.7	56.8
⅛" %	5.0	9.4	8.7	9.2	14.0	9.0	8.6	9.0	9.1	
8 %	3.0	2.7	5.6	5.2	6.1	5.6	6.6	2.7	5.2	
10 %	12.4	11.5	11.5	9.1	9.9	8.6	8.4	6.9	9.8	
20 %	6.7	4.3	4.6	4.5	5.1	4.2	4.7	4.5	5.7	
30 %	3.6	3.4	3.2	2.6	3.1	3.2	3.5	3.6	3.1	
40 %	2.7	2.0	2.4	2.2	2.1	2.4	2.2	2.2	2.3	
50 %	2.1	2.4	2.1	2.2	2.4	2.2	2.2	2.1	2.4	
80 %	1.6	1.3	1.4	1.3	1.2	1.3	1.3	1.3	1.8	
100 %	1.5	2.2	2.6	2.3	2.3	2.	2.3	2.3	2.6	1.84
200 %	2.0	2.2	2.1	2.2	2.2	2.1	2.2	2.3	2.6	2.6
Hrs. Mixed										
Batches "										
Car tracks										
% grade										

Plaintiff's Exhibit No. 59.

[Endorsed]: U. S. District Court, District of Oregon. Filed June 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

TABULATION OF ANALYSES.

of

Sixteen (16) Daily Samples of Bitulithic Mixture from SALEM–DALLAS ROAD, POLK COUNTY, OREGON, Laid by Oskar Huber in 1919.

WARREN BROTHERS COMPANY, PORTLAND LABORATORY.

Form 289 6-5-18 1m

Polk Co., Ore. — Oskar Huber, Contractor
Salem–Dallas Road

State Oregon

City Plant at Eola, Ore.

Street 1919

Date	10-5-19	10/6	10/7	10/8	10/13	10/14	10/15	10/16	10/17	10/18	10/20	10/21	10/23	10/24	10/27	10/29	Average
Lab. No.	[illegible]	02076	02092	02196	02229	02270	02303	02332	[illegible]	02407	[illegible]	[illegible]	[illegible]	02612	[illegible]	02646	
B. C. — D																	
L																	
21 flux																	
24																	
55																	
B																	
Surface Bit. Plant Hydr.																	
Lab. "																	
" °Dow																	
" °Cg																	
F. C. Bit. Pen. Hydr.																	
" °Dow																	
" °Cg																	
Bin 6																	
5																	
4																	
3																	
2																	
1																	
Dust																	
B. C. —																	
Bitumen %	6.8	6.7	6.6	6.9	6.5	6.5	6.1	6.6	6.1	6.6	6.0	6.7	6.1	6.2	6.4	6.6	6.5
Pass. 1½" %									2.5	4.1	6.0						.9
Pass. 1¼" %	9.2	11.0	3.6	10.8	14.0	6.5	7.0	9.7	16.6	9.0	14.0	14.5	11.0	8.0	15.8	10.3	10.5
1" %	21.5	21.4	19.8	19.6	8.5	15.6	23.1	21.0	12.9	11.9	16.0	19.5	16.5	18.0	9.0	20.1	16.7
¾" %	10.6	15.4	13.0	17.4	11.3	16.1	17.2	13.3	14.4	11.0	13.0	12.9	14.0	16.4	16.5	17.?	14.4
½" %	13.7	16.?	15.5	14.2	18.6	15.3	14.4	19.8	13.6	14.4	14.6	14.6	14.1	20.9	16.?	14.?	15.6
¼" %	6.3	9.2	4.0	4.2	6.2	7.3	5.5	4.0	6.5	7.5	6.5	4.5	4.1	5.2	6.3	6.5	6.2
8 %	1.8	3.3	1.6	0.5	3.0	3.0	1.8	3.3	2.9	3.5	2.5	1.4	1.5	3.2	2.6	3.0	2.1
10 %	2.6	4.3	2.5	2.3	4.3	3.3	2.5	2.7	3.9	4.2	3.7	3.6	3.0	4.3	4.0	2.5	3.3
20 %	2.9	4.0	2.7	5.4	4.5	4.0	2.2	3.0	3.5	3.3	3.4	3.7	2.0	4.2	3.2	2.6	3.5
30 %	3.9	4.7	3.3	4.7	3.0	5.0	4.4	4.5	4.5	4.1	4.9	4.1	2.9	4.4	5.0	3.3	4.4
40 %	2.4	2.4	3.6	4.4	3.4	3.2	2.6	4.4	2.9	4.1	4.0	2.5	2.1	4.9	2.5	3.3	3.6
50 %	5.0	9.4	17.6	9.3	5.2	9.3	5.3	8.1	8.1	9.9	6.4	5.2	9.3	7.5	10.6	8.5	8.9
80 %	3.5	3.2	5.0	1.8	3.2	2.8	5.5	4.7	2.6	3.3	2.5	2.4	3.8	2.6	2.9	1.8	2.9
100 %	3.5	4.3	5.4	4.9	3.8	3.9	3.6	3.1	3.6	2.9	3.6	4.1	4.4	5.1	4.1	2.6	3.9
200 %	5.9	5.6	5.0	2.6	3.6	3.6	3.3	7.0	5.9	5.5	3.6	3.8	4.6	3.9	3.6	3.6	3.6
Hrs. Mixed	8	8	8	8	7½	8	8		8	8	6	1	4	8	8	1½	
Batches " Test	26	108	36	102	[illegible]	44	47	81	47	52	44	37	61	45	76	26	
~~C...~~ % Rate		[illegible]	57		57	55	68	45	66	68	76	41			78		
% grade																	

Defendant's Exhibit "C."

[Endorsed]: U. S. District Court, District of Oregon. Filed June 8, 1922. G. H. Marsh, Clerk. No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

In the District Court of the United States for the Southern District of California, Southern Division.

No. F.–1—EQUITY.

WARREN BROTHERS COMPANY,

Plaintiff,

vs.

C. M. THOMPSON, O. M. THOMPSON, E. O. THOMPSON, Copartners Doing Business Under the Firm Name and Style of THOMPSON BROTHERS, H. E. VOGEL and J. B. HILL,

Defendants.

AFFIDAVIT OF EDWIN C. WALLACE.

United States District Court, for the Southern District of California, Southern Division.

IN EQUITY—No. F–1.

WARREN BROTHERS COMPANY, a Corporation,

Plaintiff,

vs.

C. M. THOMPSON, O. M. THOMPSON, E. C. THOMPSON, Copartners Doing Business Under the Firm Name and Style of THOMPSON BROS., H. E. VOGEL and J. B. HILL,

Defendants.

Affiant, Edwin C. Wallace, being duly sworn, declares and says:

That for more than twenty-five years he has followed the profession of Chemist, that he is a member of the American Chemical Society; The American Society for Testing Materials and the Society of Chemical Industry of London, England; that for many years he has made a specialty of testing bitumens and bituminous pavements, etc., and that the following is a chronological recital of his experience in that line of work.

From 1891 to 1894 while a special student in Chemistry at the University of Cincinnati he devoted his spare time to investigative and experimental work on asphalts and asphalt pavements under the supervision of Mr. Samuel Whinery, then General Manager of the Warren-Scharf Asphalt Paving Company with headquarters at Cincinnati.

In 1894 he regularly entered the employ of Warren-Scharf Asphalt Paving Company, assuming charge of the laboratory which had been built up during the previous years of experimental work. In 1897 he assumed charge of the laboratory of the Warren Chemical & Manufacturing Company established at their plant in Long Island City, N. Y., where they were engaged in the refining of asphalts, distillation of coal tar and the manufacture of roofing felts, mastic and other bituminous products; this company being a subsidiary of the Warren-Scharf Asphalt Paving Company; the Cincinnati Laboratory of the latter company was abandoned.

In 1900 he became first assistant in the New York Testing Laboratory, then under the direction of Clifford Richardson, said New York Testing Laboratory being the technical department of the Asphalt Company of America (now General Asphalt Company) and having technical supervision of all pavements laid by that organization and their several subsidiary companies. During the two years he was connected with this laboratory he visited many cities in the discharge of his duties and had complete charge of all the work during several months in 1900 and 1901 when Richardson was absent from the United States.

In March, 1902, he entered the employ of Warren Bros. Company of Boston as technical expert on bituminous mixtures and in the discharge of his duties visited all the plants engaged in laying the Bitulithic pavement throughout the United States of America and Canada with the exception of New England and the territory contiguous thereto over which the supervision was exercised directly by the Boston Office.

In 1907 he assumed technical direction of all work done by that Company and general control of the Laboratory, which connection lasted until 1909. In the spring of 1909, owing to ill health, he severed his connection with Warren Brothers and soon thereafter filed the application which eventuated in the patent in suit.

Affiant states that while the application for this patent was pending he made a thorough examination of United States patents pertaining to pavements,

making notes thereon and familiarizing himself with the novel features of all the important patents and he states that he has examined the list of patents offered by the defendants in this case as anticipations of the patent in suit, and states he has records of and is familiar with all but five of the patents cited, and of these five two were issued from six to eight months after the effective date of the patent in suit, and that the other three have been examined and found to have no reference or connection whatsoever with bituminous pavements or their construction; one of them referring to the construction of floors suitable for skating rinks made of Portland cement concrete, another referring to the construction of roofs composed of bituminous materials combined with coke or cork or other lightweight body materials, while the third was for a method of heating the mineral aggregate for use in bituminous concrete, which method is substantially identical with that used by Warren Brothers Company since the very inception of their business. Affiant states that no single patent cited by defendants nor any collection of them either anticipates or discloses the invention covered by the patent in suit, that of the numerous patents cited in this record many of them have not the slightest resemblance to the present construction, and that they must have been cited merely for the purpose of making a formidable appearing list of references and the most cursory examination would have shown them to be irrelevant, and that the few which might be construed as having some bearing on

the present case were cited by the Primary examiner during the prosecution of this case in the patent office, which application was finally allowed and the patent finally issued for a new and useful invention for the construction of a street pavement.

Composition or bituminous pavements derive their name from the bituminous composition used for cementing together the particles of mineral matter which forms the body of the pavement. There is no bond of union between the pieces or particles of the mineral matter other than that formed by the bituminous cement; which constitutes less than 1/8 of the mass of the pavement. A pavement of this kind may be said to consist of two distinct elements, possessing entirely different physical properties, one being the mineral or weight bearing element and the other the adhesive cementing or bonding element. From the earliest days it has been recognized that the chief problem by which the industry was confronted was how to use sufficient bituminous composition to effectively bind the mineral particles together, render the mass impervious to moisture, and still have sufficient stability to prevent the deformation or distortion of the surface caused by traffic, generally referred to as ridging, rolling, shifting or shoving. To obtain this desirable result various devices have been tried, chemicals have been used and combinations of all sorts have been made.

The term pavement is a broad one. Originally applied to floors beaten down so as to become hard, it has come into general use for any kind of a sub-

stantially rigid level surface which can be used for foot or vehicular traffic. Pavements have been constructed of plates of iron, blocks of wood, brick and stone, while composition pavements have been constructed in both block and sheet form.

The term is still further complicated by the fact that it is sometimes used to designate the entire structure including the foundation and supporting layers while at other times it refers merely to the wearing surface. This applies particularly to composition pavements as in this construction the supporting layers bear an important part. The fact has long been recognized that compositions satisfactory as foundations or supporting layers were not always satisfactory as wearing surfaces, for the chief requirement of foundation layer was capacity to withstand heavy compression and shearing strains (rigidity) while the wearing section in addition to compression, etc. is also subjected to attrition and impact, as well as being exposed to the action of the elements. It is conceivable that a rigid body might successfully withstand great compression and shearing strains but unless it was also tough and tenacious it might fail under impact and attrition.

Each fragment, piece, grain or particle of mineral matter, regardless of its size, any detached portion, may be considered as a unit. The smallest particle of dust is a unit just as much as the largest piece or fragment of stone or grain of sand or gravel. A mass of impalpable powder is merely a collection of extremely small units. However small these individual units may be they are each and every

one an aggregation of an immense number of molecules united by the force of cohesion. If a large number of very small units of mineral matter were cemented together by some adhesive material equal in strength to the force of cohesion which binds the molecules together the result would be a body equal in strength to a solid body of the same mineral matter, but where the adhesive cement is not equal in strength to the force of cohesion the result would be a body having less strength than a solid body of the mineral matter, and the greater the difference in strength between the adhesive cement and the cohesive force the greater would be the difference in the strength of the bodies. Similar results would obtain if the strength of the adhesive cement varied under different conditions. With bituminous cement that is precisely the condition which exists. The adhesive or bonding strength of bituminous cements varies greatly with the temperature. As an illustration of how the strength of bituminous cement varies with the temperature the following results may be cited. Two brass discs having slightly concaved surfaces and an area of two square inches were cemented together with ordinary paving cement made with Trinidad asphalt; at 50° F. these discs, in tension would sustain a load from 600 to 650 pounds before breaking apart. At 80° F. this load was reduced to between 75 to 90 pounds and at 90° F. no test could be made with the apparatus used as the discs pulled apart as soon as the load was applied.

When the cement was made harder to sustain loads at the higher temperature it was found that it was affected more by impact and attrition.

It can be shown that these cements are affected most by attrition and impact at the temperatures at which they sustain the greatest load under tension.

Equal volumes of mineral matter composed of large or small particles may contain the same amount or mass of mineral matter, but the surface area of the particles which has to be covered with cement in order to bond the particles together is much greater with the fine than with the coarse material.

In order to coat all the surface of all the particles it would therefore require more adhesive cement with fine than with coarse mineral matter.

In a pavement the foundation or suppotirng layers are protected from impact and the chief requirement is the power to resist displacement under heavy loads. It has long been recognized in the paving art that a mass of large stones not bonded together possesses a greater degree of rigidity than a mass of smaller stones because of the greater inertia of the large mineral units, and where rigidity is the chief requirement, it is quite natural that large stone should be used. In the foundations of all structures where conditions will permit, it is the custom to use large units of stone, and it is best to use the largest units of stone that the dimensions of the construction will permit.

In road building it has long been the custom to place the largest stones in the lowest layers. When composition pavements first came into general use, the cost of hydraulic cement was such that it was not so generally adopted for foundations as in present day construction and recourse was had to a multiplicity of layers of stone or composition superimposed one on the other.

Where layers of composition were used as supporting layers they were generally composed of an indiscriminate mixture of coarse and fine mineral units. Several layers were frequently used and it was the general custom to use the coarse material in the lower layers, each successive layer being composed of finer material. Many patents were issued for methods and products, long since abandoned, which in the light of present day practice appear absurd, but through them all it is evident that certain qualities or properties have been considered essential. When concrete came into general use and the use of bitumen derived from coal tar as cementing agent was supplanted by asphalt, natural or derived from petroleum, the construction now known as "asphalt pavement," was gradually developed. Many defects developed in the earlier constructions and the causes to which they were ascribed and the reasons given therefor were as various as the methods adopted for their correction.

It was generally conceded that a successful pavement should have sufficient resistance to compression and shearing strain to withstand heavy loads, that it should also have a certain degree of plastic-

ity in order to withstand the impact and attrition of traffic, that it should be substantially impervious to moisture and that its susceptibilty to changes of temperature should be reduced to a minimum.

Of the many patents taken out a few may be regarded as typical of the methods of construction. The patents to Scharf, Bailey, Parisen, Averill, DeSmedt and Barber refer to foundation and intermediate layers as well as wearing surface, while patents to Richardson, Warren, Whinery and Malette refer more specifically to wearing surfaces.

Other patents have been issued along these lines, differing in details, but this list is fairly representative and the patents cited are the most important.

In all cases the wearing layer is the only layer exposed to the action of traffic, the other layers being merely supports for the wearing surface. These supports in some cases were built as a single layer, in others as a plurality of layers superimposed. It is noticeable that with all the different kinds of foundation and variation in number and thickness of the supporting layers, the wearing surface has always been regarded as a thing apart, an entity, separate and complete. The thickness of the supporting layers varies from one inch to one foot but the thickness of the wearing surface has practically been confined to within the narrow limits of 1½ to 3 inches.

Many different bituminous compositions have been used in both supporting and wearing layers and mineral aggregates of many kinds and sizes have been used, but the wearing layer has always differed

in some respect from the underlying layers. When composed of similar materials something has always been added to or omitted from the composition of the wearing layer and apparently it was always considered necessary that it should be of substantially uniform composition throughout its thickness. That results have not been altogether satisfactory is evidenced by the number of patents issued to remedy defects and that there was also a wide divergence of opinion as to the best method of accomplishing that result is evidenced by the variety of methods as expressed in the patents.

Averill's patent No. 211,313 provided that the layers should be unattached so as to move freely on each other. Eight years later the DeSmedt patent No. 375,273 was granted, claiming that greater strength was imparted to the wearing layer by interposing a layer of "binder" between the concrete and the wearing layer and causing the two layers, binder and wearing surface, to adhere. This is diametrically opposed to Averill's idea. The Barber patent No. 391,222 considers it still better to cause three layers to adhere and therefore substitutes for DeSmedt's concrete a layer of bitumen coated stone. The wearing layer in all these cases was substantially the same, a fine mineral aggregate, sand, combined with a bituminous cement composed of Trinidad asphalt softened with petroleum residuum. Each of them, Averill, DeSmedt, Barber, all men versed in the art, tried to improve the wearing surface by changes made in the underlying supporting layers. Scharf, Bailey and Parisen also

show the greatest variations in their underlying supporting layers but even in this respect Bailey and Parisen are much alike but Parisen's idea seems to be more in accord with DeSmedt's than Averill's since he tried to insure bonding the layers together by sprinkling each of them, after compression, with the same bitumen used in the construction. Any one of the layers of Scharf, Bailey, and Parisen could have been substituted for any one of the layers described by the others and practically the same results obtained, since each layer was complete in itself and substitution of one layer for another would not have affected contiguous layers in the slightest degree.

In 1898 Clifford Richardson obtained a patent, No. 697,884, in which an attempt was made to regulate the proportion of various sized units of the mineral aggregate and by this regulation control, within certain limits, the amount of bituminous cement required to coat the particles.

Richardson directed his development entirely to the wearing surface, assuming that the problem so far as underlying layers were concerned was solved.

Richardson was an advocate of fine mineral aggregates and in this patent the largest units passed a screen of 10 meshes per linear inch.

Richardson laid his wearing surface two inches thick and uniform throughout its depth.

In the construction of wearing surfaces use has been made of coarse aggregates and fine aggregates, but whatever the nature of the aggregate

or the kind of bituminous cement used special efforts appear to have been made to have them uniform throughout the layer and wherever the thickness has been specified it falls within the limits of 1½″ to 3″.

Warren, Whinery and Malette, the more recent advocates of the use of coarse rather than fine mineral aggregates also produce wearing surfaces substantially uniform throughout, Malette does spread some fine mixture over the top of his wearing surface composed of coarse aggregate after it has been thoroughly compressed but states specifically that it is NOT AN ESSENTIAL feature of his invention but is merely resorted to to give a finish (temporarily), and in an alternative which he desribed he omits the fine mixture entirely and uses a finishing layer of limestone screenings or fine gravel without any coating of pitch or bitumen.

In practice, whenever coarse aggregate has been used it has been found necessary to paint the top of the wearing layer with more or less liquid bitumen in order to seal the top of the surface and render it impervious to moisture.

Prior to 1901 coarse aggregates for bituminous wearing surfaces had seldom, if ever, been used successfully.

In 1901 patents were issued to Warren, Whinery and Malette for construction of bituminous wearing surfaces in which coarse mineral aggregate was used.

The only thing in common in the patents issued

to these three different persons was the use of coarse aggregate for the wearing surface.

Both Mr. Warren and Mr. Whinery had had years of experience in the construction of "asphalt pavements," each had recognized that there was something lacking in that method of construction and each had turned to the use of coarse stone in the wearing surface to correct what they considered defective construction. In the course of the next few years other patents along similar lines were issued to Warren, and one in particular, No. 727,505, has been finally adjudged to be a valid patent after protracted litigation as to its novelty and utility.

Prior to the Warren patent, broken stone or gravel had been used mixed with fine mineral matter or sand for the construction of bituminous wearing surfaces, but no attempt had been made to grade and re-combine the different sized particles in predetermined proportions. Warren adopted the method of determining the sizes of the particles within certain limits and then combining the coarse with the fine in proportions best adapted to secure a certain result which he termed "inherent stability." He had determined by experiment that by mixing the coarse and fine aggregates of the material to be used in proportions varying according to the sizes of the respective materials, mixtures could be made in which the voids were greatly reduced and stability greatly increased. His idea was to use the largest possible amount of coarse material with fine material merely suffi-

cient to reduce the voids to a minimum, this aggregate then to be combined with bituminous cement and laid and compressed in the usual manner.

In practice, however, it was soon found that the maximum of coarse material as indicated by the void test did not give the best result, owing to the tendency of the coarse particles to crush under traffic and a decided modification had to be made; the resulting mixture, however, still came within the scope of the Warren patent as the voids were unquestionably low and the mixture stable.

The stress and strain to which a composition pavement is subjected is not uniform throughout the thickness of the layer, but varies both in kind and intensity at different depths of the layer.

These might be roughly defined as general strain to which a section would be subjected throughout its depth, as compression, and special strain such as impact which acts directly upon the superficial area of the layer.

Examinations of samples of bituminous pavements which have been subjected to traffic show conclusively that in the superficial area of the wearing surface, subjected directly to the impact of traffic the mineral matter is crushed and reduced to a finer state of subdivision than the mineral matter in the lower portion of the layer, although at the time of laying the same material had been used throughout. The coarser the grains of the mineral matter used the greater the relative reduction in size and con-

sequent increase in the number of detached grains or particles of mineral matter.

The only bond of union between the units of mineral matter is that afforded by the bituminous cementing medium and the amount of that medium which can be used is controlled by the size of the units, the larger the units the smaller the proportion of the cementing medium; this cement merely coats the surface of the mineral units and does not penetrate into the body thereof.

It follows therefore that when the units are broken, surfaces which are not coated by the cementing medium are exposed, at least two uncoated surfaces for each fracture of a grain or particle. These uncoated surfaces are a source of weakness, and the degree of weakness depends entirely on the composition of the layer. If the mineral units are small and the proportion of cementing medium sufficient, under the kneading action of traffic, these surfaces may become re-coated with the cementing medium; but where the mineral units are large the proportion of the cementing medium is less and the greater inertia of the units offers greater resistance to the kneading action of traffic so that the dry surfaces are not so likely to become coated by the cementing medium; these dry surfaces permit the ready absorption of moisture and disastrous results usually follow.

The tendency of loads moving over the surface of a pavement is to push the wearing surface ahead of the load, while the foundation on which the layer is supported tends to maintain the layer in a state

of rest. These counterforces cause a stress and strain to be set up within the mass of the layer and cause the separate units of mineral matter to move, one on the other if not evenly supported on all sides.

Warren recognized this and attempted to correct it by producing a mineral aggregate which was firm in itself, by reducing the voids in the aggregate to the lowest practical degree.

Warren's idea was a step in the right direction, but the volume of voids cannot be controlled solely by regulating the quantity of each of the various sizes of units which compose the aggregate. The juxtaposition of the units is also an important factor. No control could be exercised under the Warren patent.

The key note is the relative position of the units, and that cannot be controlled by making a promiscuous mixture of large and small units from top to bottom of the wearing surface, even though the number of units of various sizes be limited.

Warren was chiefly concerned with the composition of his wearing surface, practically all his efforts being centered on the sizing and proportioning of the particles, or units, of the mineral aggregate employed, and this was the same throughout the layer, or as Warren says in patent No. 727505 "the grades being thoroughly mixed and thereby being properly distributed throughout the mass."

In the patent in suit the chief concern does not lie with the composition of the wearing surface nor with the composition of the mixtures used in the

formative process, but lies chiefly with the structure of the completed wearing surface as produced, irrespective of the actual composition of the material used.

The novelty and utility of this method of construction is beyond question and wherever it has been tried in comparison with other forms of construction has always proven its worth, frequently to the exclusion of older and more widely known methods of construction.

One of the unusual and novel features of this method of construction, necessary to produce the desired result and one which at the outset was considered highly objectionable is the necessity of handling the two kinds of mixture (coarse and fine) substantially concurrently.

It is well known that in the practice of constructing a pavement built up of layers of mixtures of different composition, it is the custom to lay one layer at a time, frequently for several days, then to change to another mixture for the next layer. In the method, covered by the patent in suit, however, it is necessary to follow up the coarse mixture with the fine before the former has become cold in order to secure the proper compression on the coarse mixture and also assure the desired blending and bonding of the two mixtures into a single non-cleavable layer. If this blending and bonding is not secured and the fine mixture does not become an integral part of the coarse layer, it scales off or wears away or becomes distorted within a few weeks or months according to traffic conditions.

Where the two mixtures have been properly blended and bonded together and the fine mixture becomes an integral part of the pavement, it has lasted for years under traffic conditions which have fully demonstrated its improvement over other methods of construction.

By the preferred method of construction pointed out by the patent in suit the large mineral units of the lower layer are neither in close contact nor in fixed position relative to each other when the fine mixture is spread over the top, but are disposed loosely on the foundation. The pressure which brings the large units into close contact and bonds them together acts first on the fine mixture and tends to force it into the interstices of the upper portion of the layer of coarse mixture and at the same time it consolidates said layer by causing a change in the relative position of the particles of which it is composed.

The two mixtures are thus caused to blend and become bonded together without joint, or cleavage-like plane of union, and cannot be separated into their original parts. Since the force which causes the fine mixture to blend with the coarse is the identical force which brings the units of the lower layer into closer relation and into fixed position relative to each other, the interaction is such that stable equilibrium is established. The large mineral units at the top of the layer of coarse mixture are thus firmly wedged into position and effectively supported on every side, instead of being merely seated

on underlying particles without proper lateral support.

This lateral support acts as a preventive of the rolling or rocking of the large units upon each other, or upon the matrix of fine mixture, and it may be likened to the construction of an ordinary arch of masonry, where by means of wedge shaped blocks and a keystone vertical stress is so resolved into transverse stress that the load is supported by piers at the side but not directly under the load. By having the large units supported laterally, a stress which would tend to move a unit in a vertical direction would have less effect on that unit than it would if such support were lacking. If the resistance at all points were equal to the stress, it is obvious that the unit would remain at rest, but if, in any direction, the resistance does not equal the stress obviously the unit would move in the line of least resistance and a rocking or rolling motion would be imparted to units which are not supported laterally as well as vertically.

Warren, Whinery and Malette, the three latest advocates of the use of coarse mineral aggregates for wearing surfaces of composition pavements, were in accord in the idea that with such aggregates "the stone takes the wear."

When reduced to practice it was soon found that this was true, literally true; the stone took the wear to an extent which was surprising and the pavements were often much the worse for it within a very short period of time. Malette realized this and within four months from the date of his first

patent had obtained a second one in an effort to correct the defects of the first. Warren also found it necessary to modify his construction by increasing the proportion of fine material above that indicated by the void test as giving the lowest percentage of voids. The difference between the lowest possible and the lowest practicable percentage of voids was one which often called for great nicety of decision.

In the patent in suit "the stone bears the load," as it is well suited to do, but it is protected from "wear" by a relatively thin coat of impact-resisting mixture, which is in turn protected from deformation or displacement by the "load-bearing stone." By discarding uniformity of composition throughout the entire mass for adaptability to resistance to stress, a wearing surface is produced which is stable where stability is most needed, but plastic where plasticity is more desirable.

This impact-resisting coat serves the double purpose of protecting the stone from abrasion, and also renders the surface substantially impervious to moisture. The product produced by this method of construction is complete within itself with maximum resistance to the effect of traffic and to the action of the elements as well.

Warren found by experience he had to provide some means of rendering the superficial area of the wearing surface produced by his process less pervious to moisture; he therefore painted the surface with a liquid bituminous composition afterwards spreading stone chips over the paint. The

necessity of applying the liquid paint composition shows that the Warren product, which theoretically was correct in principle, was not practically "complete in itself" but required an additional step in the process of construction.

This paint method of sealing the surface was a return to the practice of earlier days, and was soon found to be a source of annoyance and often of considerable expense, as no practical method was ever found by which it could be kept under reasonable control.

In practice under the Warren patent the effort was made to provide a malleable fine bituminous surfacing by using a surplus of the fine ingredients and bitumen with the coarse aggregate comprising the wearing section and depending upon compression to bring this surplus fine aggregate and bitumen to the surface. This was partly accomplished but at the expense of detracting from the stability of the entire structure because it left a surplus of the bituminous mortar element throughout the structure. Under the patent in suit the extremely desirable malleable surface is accomplished and at the same time the stability of the structure retained.

Construction under the patent in suit does not produce a multi-layer pavement, but a combination of two dissimilar mixtures into a single layer with a merging of coarse into fine or fine into coarse, viewed from the bottom up or the top down. A sectional view could not be represented by two parallelograms with one side common to both, as neither the base line of the fine aggregate topping

mixture nor the top line of the coarse aggregate body mixture, could be represented by a straight line, but rather by one which is irregular, sinuous and deeply indented. A structure is thus produced composed of elements, each of which is best adapted to the purpose for which it is intended. The load-bearing element containing large mineral units, which impart stability, is used only where stability is the essential feature, while the impact-resisting element is composed of small mineral units as being best adapted to resist abrasion by its pliability. By blending these two elements together the change from stability to pliability is more gradual than could otherwise be obtained. It is doubtful if any two sections could be made through this structure, in any direction, which would show the same composition or the same relative proportions of the two mixtures.

In a multi-layer pavement there is a plurality of layers of composition; each layer, while it may differ from contiguous layers, is substantially uniform throughout. A section through any one of the layers, through any part thereof, or in any direction would show it to be substantially uniform as to both composition and thickness. Each of the layers being of uniform composition would possess the same characteristics or properties throughout, and the superimposed layers might be likened to a number of boards glued together. The boards might vary in thickness and be made from various woods but there would be no blending parts such as oc-

curs when two pieces of metal are welded together.

The difference between composition and structure may be shown by the well known type of road known as macadam, which is a structure and not a composition, as it is not uniform throughout the thickness of the wearing layer.

In this construction a layer of stone is placed upon a previously prepared base and fine material forced in from the top by the kneading action of a roller, so as to secure lateral support for the stone forming the body of the roadway. In this way a firm and substantial structure is produced without recourse to adhesive cements. The same results could not be obtained by mixing coarse and fine aggregate indiscriminately and then placing a layer of identical thickness upon the same base and compressing it with the same roller. No matter how carefully the proportions of coarse and fine material were determined the results would not be the same.

The excellent results obtained with the ordinary macadam roadway has caused many paving experts to attempt to reproduce it with the addition of an adhesive cementing medium like bituminous cement. Unfortunately this has generally been done without taking into consideration the change wrought by the addition of such adhesive material.

In plain or so-called waterbound macadam it is necessary to compress the layer of stone forming the body of the roadway before applying the fine material, as otherwise the fine material works

through the mass to the bottom of the layer of coarse stone, with unsatisfactory results.

Furthermore, the water applied during the later compression, is a mobile liquid which readily permeates the mass, carrying with it the finer particles of dust into the smallest of the interstices and since the stone wears more by attrition when watersoaked some of the extremely fine dust is doubtless formed "in situ" and acts to wedge the stone in place.

All this is changed, however, when bituminous cement is used, since its viscous adhesive nature prevents the very action on which the success of the process so largely depends. Efforts to use bituminous material in this way have usually resulted in the production of multi-layer pavements with most of the layers lacking in stability. Except under extremely light traffic conditions, results have never been satisfactory.

In the patent in suit this difficulty has been overcome by producing a wearing surface consisting of a single layer, one and inseparable, a structure with the different sizes of the mineral aggregate placed where they are most needed rather than a mere compound.

To adapt various parts of the structure to resist the particular stresses to which they would be subjected seemed to be more logical than to make predominant any one quality at the expense of others equally necessary.

This can be accomplished by following the process covered by the patent in suit.

The large mineral units of the body of the layer

impart stability thereto while fine mineral units, which are less injuriously affected by impact, are used to advantage in that portion subjected to the direct action of traffic.

It is the blending, the welding, the amalgamation into a compact integral mass, which permits the use of a plastic fine mixture made so rich in bituminous content as to best accomplish the result, and also permits the reduction of the thickness of that portion of the layer so that stress and strain are minimized by the gradually increasing stability of the mass from the top downward, thus accomplishing an important result which could not be accomplished with any previous construction.

Affiant states that he has carefully compared the specifications entitled "Asphalt Concrete A" under which the pavement constructed by defendants was laid with the specifications and claims of the patent in suit and also what purported to be a sample of the pavement actually laid by defendant and in his opinion the specifications require the construction of a pavement which will infringe the claims of the patent, and the examination made of the samples submitted to him prove that the process pointed out by the patent to produce that product must have been substantially complied with.

(Signed) EDWIN C. WALLACE.

Subscribed and sworn to before me this 26th day of May, 1921.

[Seal] (Signed) ROBERT FOWLER,
Notary Public.

Commission expires March 7, 1924.

ROBERT FOWLER,
Notary Public.

In the District Court of the United States for the Southern District of California, Southern Division.

IN EQUITY—No. F–1.

WARREN BROTHERS COMPANY, a Corporation,

Plaintiff,

vs.

C. M. THOMPSON, O. M. THOMPSON, E. C. THOMPSON, Copartners Doing Business Under the Firm Name and Style of THOMPSON BROS., H. E. VOGEL and J. B. HILL,

Defendants.

CLERK'S CERTIFICATE.

I, Chas. N. Williams, Clerk of the United States District Court for the Southern District of California, do hereby certify the foregoing to be a full, true and correct copy of the affidavit of Edwin C. Wallace filed in my office on June 3, 1921, in the case entitled Warren Brothers Company v. Thompson Brothers, No. F–1 Equity, as the same remains on file and of record in my office.

ATTEST my hand and seal of the United States District Court this —— day of March, A. D., 1922.

[Seal] CHAS. N. WILLIAMS,

Clerk U. S. District Court, Southern District of California.

By R. D. Zimmerman,

Deputy.

United States of America,
State of Colorado,
City and County of Denver.

I, O. W. Jehovah, being duly sworn *and* say: That I am a Photographer and personally took and made the Photograph shown on the opposite side of this paper and said Photograph is a true and correct picture and representation of what appears thereon and shows a portion of the pavement laid in that half of the alley which abuts upon the Undertaking Establishment of E. P. McGovers, 1442 Arapahoe Street; said Photograph was taken on the 27th of March, 1922, in the presence of the persons shown in the picture.

My Business Address is 320 17th Street, City.

O. W. JEHOVAH.

Subscribed in my presence and sworn to before me this 7th day of April, A. D. 1922.

[Seal] JOHN H. MOONEY,
Notary Public.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.

Defendant's Exhibit "E."

United States of America,
State of Colorado,
City and County of Denver.

I, O. W. Jehovah, being duly sworn *and* say: That I am a Photographer and personally took and made the Photograph shown on the opposite side of this paper and said Photograph is a true and correct picture and representation of what appears thereon and shows a portion of the pavement laid in that half of the alley which abuts upon the Undertaking establishment of E. P. McGovern, 1442 Arapahoe Street; said Photograph was taken on the 27th of March, 1922, in the presence of the persons *showing* in the picture.

My Business Address is 320 17th Street, City.

O. W. JEHOVAH.

Subscribed in my presence and sworn to before me this 7th day of April, A. D. 1922.

[Seal] JOHN H. MOONEY,
Notary Public.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.


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United States of America,
State of Colorado,
City and County of Denver.

I, O. W. Jehovah, being duly sworn *and* say: That I am a Photographer and personally took and made the Photograph shown on the opposite side of this paper, and said photograph is a true and correct picture and representation of what appears thereon and shows the full alley in the rear of McGovern's Undertaking Establishment at 1442 Arapahoe Street. The dark spot at the feet of L. A. Liljequist was not a hole but a damp spot in the pavement.

O. W. JEHOVAH.

Subscribed and sworn to, before me, this 7th day of April, 1922.

[Seal] JOHN H. MOONEY,
Notary Public.

[Endorsed]: U. S. District Court, District of Oregon. Filed Jun. 8, 1922. G. H. Marsh, Clerk.

No. 4171. United States Circuit Court of Appeals for the Ninth Circuit. Filed Jan. 2, 1924. F. D. Monckton, Clerk.